CANADIAN SPACE AGENCY

2012–13

Departmental Performance Report

Minister of Industry

TABLE OF CONTENTS

Minister's Message 1

SECTION 1: ORGANIZATIONAL OVERVIEW 2

1.1 Raison d'Être 2
1.2 Responsibilities 2
1.3 Strategic Outcome and Program Alignment Architecture 3
1.4 Organizational Priorities 6
1.5 Risk Analysis 13
1.6 Summary of Performance 15
1.6.1) Summary of Performance Tables 16
1.7 Expenditure Profile 18
1.8 Estimates by Vote 19
1.8.1) Strategic Environmental Assessment 19

SECTION 2: ANALYSIS OF PROGRAMS BY STRATEGIC OUTCOME 20

2.1 Strategic Outcome 20
2.2 Programs' Performance and Lessons Learned 20
2.2.1) PROGRAM – 1.1. SPACE DATA, INFORMATION AND SERVICES 20
2.2.2) PROGRAM – 1.2. SPACE EXPLORATION 47
2.2.3) PROGRAM – 1.3. FUTURE CANADIAN SPACE CAPACITY 69
2.2.4) PROGRAM – 1.4. INTERNAL SERVICES 85

SECTION 3: SUPPLEMENTARY INFORMATION 88

3.1 Financial Highlights 88
3.1.1) Condensed Statement of Operations and Departmental Net Financial Position 88
3.1.2) Condensed Statement Financial Position 89
3.2 Financial Highlights Graph 90
3.3 Financial Statements 93
3.4 List of Supplementary Information Tables 93
3.5 Tax Expenditures and Evaluation Report 93

SECTION 4: OTHER ITEMS OF INTEREST 94

4.1 Organizational Contact Information 94
4.2 Additional Information 95
4.2.1) Spending by Program 95
4.2.2) FTEs Variance (Full–Time Equivalent) 96

MINISTER'S MESSAGE

I am pleased to report on the Industry Portfolio's key activities for 2012–13.

During this period, the Portfolio continued to develop and recruit leading research talent through programs administered by the federal granting councils. It also took significant steps to improve commercialization outcomes through the transformation of the National Research Council into an industry-focused research and technology organization. This was complemented by reinvestments in programs such as the College and Community Innovation Program and the Centres of Excellence for Commercialization and Research.

Last year, the Government of Canada, through the Canadian Space Agency (CSA), achieved unprecedented recognition for Canada's role in space as a key partner in the International Space Station (ISS). During Expedition 34/35, Chris Hadfield became the first Canadian to command the ISS, and the CSA contributed to 26 scientific studies and technology demonstrations, including the first Robot Refuelling Mission. The next phase of the RADARSAT Constellation Mission was initiated, which improves capabilities of previous earth observation remote-sensing satellites. Images produced by these satellites support the critical operational needs of many government departments and contribute to essential surveillance over Canada's coastal approaches in the Arctic. In addition, the CSA successfully launched the first Near-Earth Object Surveillance Satellite dedicated to detecting and tracking asteroids, satellites and space debris.

Moving forward, the Industry Portfolio will continue to exercise fiscal responsibility while delivering on government priorities to support jobs and economic growth. Portfolio agencies will continue to play key roles in encouraging collaboration between the research community and the private sector; strengthening the manufacturing sector to sustain and attract globally competitive industries; and bringing forward the government's response to the Review of Aerospace and Space Programs and Policies to maintain Canada's leadership position in those areas.

It is my pleasure to present the 2012–13 Departmental Performance Report for the Canadian Space Agency.

James Moore
Minister of Industry

SECTION 1: ORGANIZATIONAL OVERVIEW

1.1 RAISON D'ÊTRE

The mandate of the Canadian Space Agency[1] (CSA) is *"to promote the peaceful use and development of space, to advance the knowledge of space through science and to ensure that space science and technology provide social and economic benefits for Canadians"*.

The CSA is achieving this mandate in cooperation with Government of Canada (GoC) organizations, industrial firms, and universities, as well as international partners.

CSA in brief in 2012-13

Minister of Industry:
The Honourable James Moore

President: General (Retired)
Walter Natynczyk

Budget: $386.6 million

Headquarters:
Saint-Hubert, Quebec

Full Time Equivalent (FTE): 643.5

Partners: Government of Canada (GoC) organizations, Canadian academia and space industry, and international space agencies.

1.2 RESPONSIBILITIES

The founding legislation that received Royal Assent in 1990 attributed four main functions to the CSA:

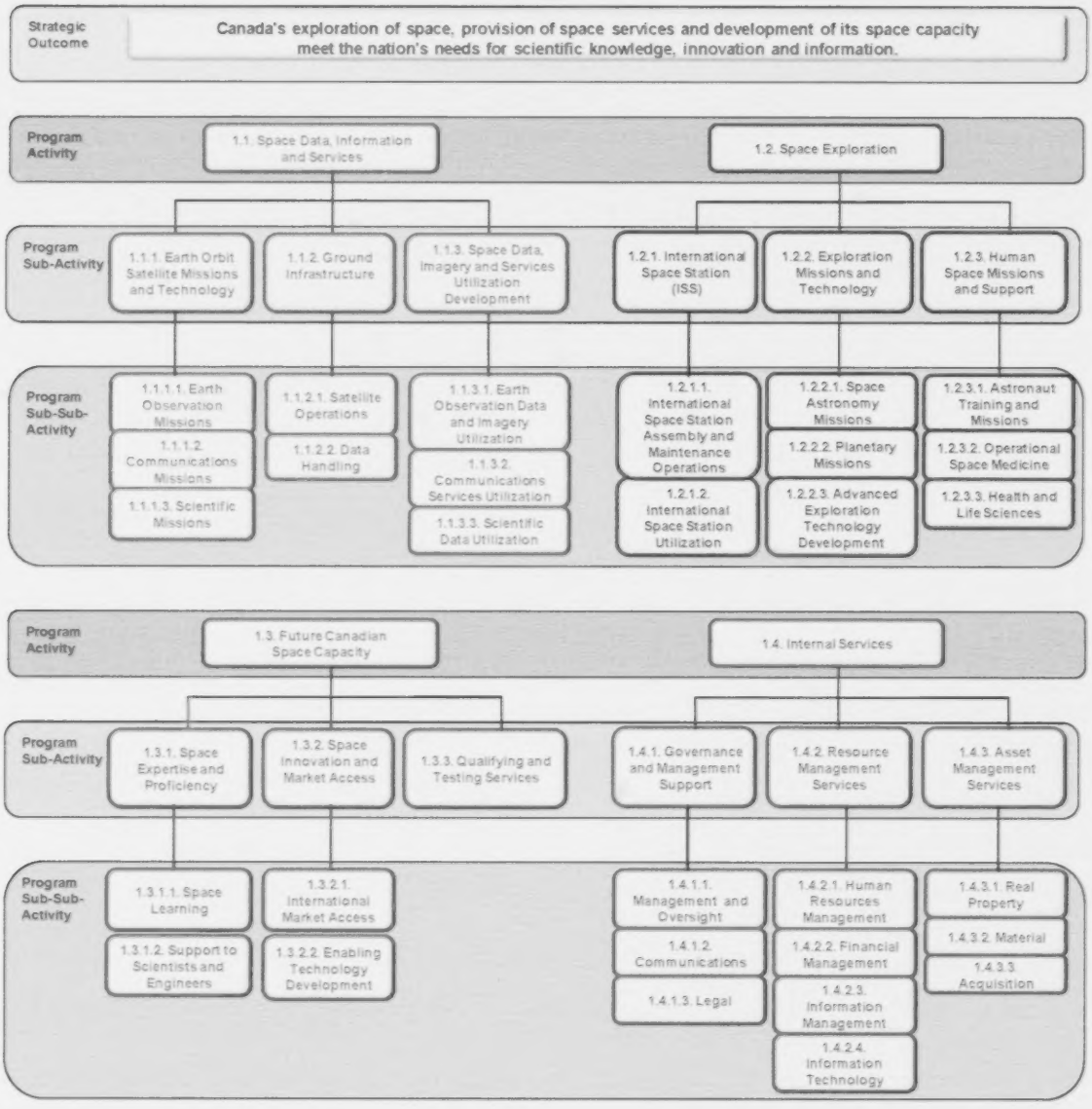
- Assisting the Minister in the coordination of the space policies and programs;
- Planning and implementing programs and projects related to scientific or industrial space research and development, and application of space technology;
- Promoting the transfer and diffusion of space technology to and throughout Canadian industry; and
- Encouraging commercial exploitation of space capabilities, technology, facilities and systems.

[1] To learn more about the mandate of the Canadian Space Agency, go to: http://www.asc-csa.gc.ca/eng/about/mission.asp

1.3 STRATEGIC OUTCOME AND PROGRAM ALIGNMENT ARCHITECTURE

The Canadian Space Agency's programs[2] are specifically targeted to achieve the overarching Strategic Outcome: *"Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information"*.

CSA's 2012–13 Program Alignment Architecture


Strategic Outcome
Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information.
Program Activity
1.1. Space Data, Information and Services
1.2. Space Exploration
Program Sub-Activity
1.1.1. Earth Orbit Satellite Missions and Technology
1.1.2. Ground Infrastructure
1.1.3. Space Data, Imagery and Services Utilization Development
1.2.1. International Space Station (ISS)
1.2.2. Exploration Missions and Technology
1.2.3. Human Space Missions and Support
Program Sub-Sub-Activity
1.1.1.1. Earth Observation Missions
1.1.1.2. Communications Missions
1.1.1.3. Scientific Missions
1.1.2.1. Satellite Operations
1.1.2.2. Data Handling
1.1.3.1. Earth Observation Data and Imagery Utilization
1.1.3.2. Communications Services Utilization
1.1.3.3. Scientific Data Utilization
1.2.1.1. International Space Station Assembly and Maintenance Operations
1.2.1.2. International Space Station Utilization
1.2.2.1. Space Astronomy Missions
1.2.2.2. Planetary Missions
1.2.2.3. Advanced Exploration Technology Development
1.2.3.1. Astronaut Training and Missions
1.2.3.2. Operational Space Medicine
1.2.3.3. Health and Life Sciences
Program Activity
1.3. Future Canadian Space Capacity
1.4. Internal Services
Program Sub-Activity
1.3.1. Space Expertise and Proficiency
1.3.2. Space Innovation and Market Access
1.3.3. Qualifying and Testing Services
1.4.1. Governance and Management Support
1.4.2. Resource Management Services
1.4.3. Asset Management Services
Program Sub-Sub-Activity
1.3.1.1. Space Learning
1.3.1.2. Support to Scientists and Engineers
1.3.2.1. International Market Access
1.3.2.2. Enabling Technology Development
1.4.1.1. Management and Oversight
1.4.1.2. Communications
1.4.1.3. Legal
1.4.2.1. Human Resources Management
1.4.2.2. Financial Management
1.4.2.3. Information Management
1.4.2.4. Information Technology
1.4.3.1. Real Property
1.4.3.2. Material
1.4.3.3. Acquisition

[2] Description of Programs are taken from the Main Estimates available on line:
http://www.tbs-sct.gc.ca/rpp/2011-2012/inst/csa/csa02-eng.asp#s2.2
http://www.tbs-sct.gc.ca/est-pre/20112012/me-bpd/docs/me-bpd-eng.pdf

Short Description of Programs and Sub–Programs

1.1. Space Data, Information and Services: This Program includes the provision of space–based solutions (data, information and services) and the progression of their utilization. It also serves to install and run ground infrastructure that processes the data and operates satellites.

- **1.1.1. Earth Orbit Satellite Missions and Technology:** This Sub–Program (SP) fosters Government of Canada (GoC) organizations to use satellite–generated data, information and services to deliver their mandate; and so do academia to perform their research.
- **1.1.2. Ground Infrastructure:** This SP fosters satellites to operate as well as to process and make available space–based data received by the Canadian Space Agency to assist GoC organizations in delivering their mandate.
- **1.1.3. Space Data, Imagery and Services Utilization Development:** This SP fosters the development of a Canadian value–added industry that turns space data and information into readily useable products, as well as to increase the ability of GoC organizations to use space–based solutions (data, information and services) for the delivery of their mandate and to increase the ability of academia to perform their research.

1.2 Space Exploration: This Program provides valuable Canadian science, signature technologies and qualified astronauts for international space exploration endeavours.

- **1.2.1. International Space Station (ISS):** This SP fosters specific understanding and technological advances to generate and to prepare for the challenges of space exploration and for terrestrial benefits. This SP provides Canadian industrial firms and academia privileged access to the ISS.
- **1.2.2. Exploration Missions and Technology:** This SP fosters international space exploration endeavours as it contributes to valued Canadian signature technologies and generates a better understanding of the universe, the solar system and our home planet.
- **1.2.3. Human Space Missions and Support:** This SP fosters specialized knowledge to generate in fields that sustain human space flights, such as life sciences and space medicine.

1.3 Future Canadian Space Capacity: This Program attracts, sustains and enhances the nation's critical mass of Canadian space specialists, fosters Canadian space innovation and know–how, and preserves the nation's space–related facilities capability. In doing so, it encourages private–public collaboration that requires a concerted approach to future space missions.

- **1.3.1. Space Expertise and Proficiency:** This SP fosters a pool of space expertise and proficiency to create and sustain and will form the next generation of space professionals and workers, continuously able to provide solutions for future Canadian space endeavours.

- **1.3.2 Space Innovation and Market Access:** This SP fosters entrepreneurship that enhances Canadian industry's international positioning on commercial and government markets.
- **1.3.3. Qualifying and Testing Services:** This SP fosters that mission–assigned technology and entire systems can safely ensure and reliably meet the rigors of space and to demonstrate the suitability and effectiveness of new Canadian space technology for providing valuable contributions to space missions.

1.4 Internal Services: In accordance with the Management Accountability Framework this Program serves to implement the government's commitment to modern Public Service management. Internal Services include only those activities and resources that apply across an organization in the areas of Governance and Management Support which includes Management and Oversight Services, Communications Services, and Legal Services; Resource Management which includes Human Resources Management Services, Financial Management Services, Information Management Services and Information Technology Services; and Asset Management which includes Real Property Services, Material Services and Acquisition Services.

The CSA implemented its revised PAA in 2011–12[3]. Therefore, this performance measurement reporting cycle represents a second year of data collection. The capacity to fully compare Research and Development (R&D) results will begin in 2013–14 with a third consecutive year of data collection.

[3] For more information on the Program Alignment Architecture, go to: http://www.asc-csa.gc.ca/eng/publications/rp.asp#rp

1.4 ORGANIZATIONAL PRIORITIES

SUMMARY OF PROGRESS AGAINST PRIORITIES

The CSA had identified eight operational priorities for 2012–13. Progress being made in each of these priorities is outlined below.

Program: SPACE DATA, INFORMATION AND SERVICES (SDIS)	
SDIS Priority #1	**Type[4]**
Further the development of the RADARSAT Constellation Mission (RCM) in order to provide continuity and enhanced functionalities to the users of RADARSAT-1 and RADARSAT-2.[5] Ground stations located in the Canadian Arctic are required to take full advantage of the RCM and to receive data from various Canadian and foreign satellites.	Ongoing
Summary of Progress	
The design of the RCM was completed in November 2012 with a successful Mission Critical Design Review (CDR) approved by stakeholders. In December 2012, Treasury Board approved the implementation and early operations phase of the RCM. The contract for this portion of the work was subsequently awarded to MDA Systems. The launch of the three-satellite constellation is scheduled for fiscal year 2018–19. While the RCM will ensure the continuity of Earth observation data from space for many government departments, it will also enhance Canada's ability to use space-based solutions for operational maritime surveillance, disaster management, natural resources management and ecosystem monitoring and will support Canada's strategic security and sovereignty objectives, particularly in the Arctic. Due to a major technical anomaly, its predecessor RADARSAT-1 stopped providing data on March 29, 2013 after more than 17 years of reliability. The CSA continued to take advantage of Canada's favourable northern location by exploring the feasibility of hosting satellite data reception stations in the North.	
SDIS Priority #2	**Type**
Further study the development of the Polar Communication and Weather (PCW) mission. This key space asset will provide the sole broadband for communications services and weather observations in the Canadian Arctic to support the Canadian Forces' operations and help Government of Canada organizations foster social and economic development in the high Arctic.[6]	Previously committed

[4] Type is defined as follows: **previously committed to**—committed to in the first or second fiscal year before the subject year of the report; **ongoing**—committed to at least three fiscal years before the subject year of the report; and **new**—newly committed to in the reporting year of the Report on Plans and Priorities (RPP) or Departmental Performance Report (DPR).

[5] This priority is from page 14 of the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf

[6] This priority is from page 14 of the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf

Summary of Progress
The CSA finalized the analysis of delivery mechanisms for the Polar Communication and Weather (PCW) Mission, including a private–public–partnership (PPP) to find the most efficient way to meet the needs expressed by other government departments and northern communities in Canada. A mission concept consisting of satellites in Highly Elliptical Orbits (HEO) was developed jointly with industrial firms and confirmed to be feasible (Phase A study completed in March 2013). International partners on the military and civilian sides as well as DND (communications), EC (meteorology) and NRCAN (space weather) have been actively engaged since the beginning. The northern circumpolar region presents unique challenges and is not currently supported by dedicated meteorological, communications or climate–monitoring instruments. GoC organizations operating in this remote region, civil aviation aircraft flying over the Arctic, the increasing number of ships navigating in ice-filled northern waters, and remote communities require these services to safely carry out their operations and sustain their development. The concept studies were completed and the details were shared with key stakeholders.

Program: SPACE EXPLORATION (SE)	
SE Priority #1	**Type**
Canada will continue as an active partner and participant in the International Space Station (ISS), operating robotic elements such as Canadarm2 and Dextre, conducting scientific experiments and technology demonstrations, and securing flight opportunities for Canadian astronauts.[7]	Ongoing

Summary of Progress

The CSA fulfilled its ISS obligations by operating the Mobile Servicing System (MSS) to meet all scheduled ISS operational requirements. Major operations included the capture, installation and release of four cargo vehicle flights to the ISS. Other operations included the relocation of On-Orbit Replaceable Units (ORUs) about the ISS, Extravehicular Activity (EVA) viewing support, ISS inspection activity, and MSS element relocations on the ISS. Operational support also involved providing technical support for the MSS hardware and software, continuing the repair and overhaul of failed hardware, providing MSS-related training to astronauts and ground personnel, developing and certifying future MSS operations, and conducting operations in conjunction with the NASA Houston flight control room from the Remote Multi-Purpose Support Room in St. Hubert, Quebec.

In view of extending the life of the operational use of the ISS, the CSA completed its technical assessment of the Mobile Servicing System. In February 2012, the Government of Canada announced its commitment to continue Canada's participation in the ISS to 2020.

This year, Canadians reached a new level of pride in, and recognition and awareness of the Canadian Space Program as astronaut Chris Hadfield became the first Canadian to command the ISS. During his five-month mission from December 2012 until May 2013, Chris Hadfield and his crew set new records for the amount and quality of science experiments conducted onboard the ISS. The following are a few examples of scientific-studies and technology demonstrations:

- Binary Colloid Alloy Test (BCAT-C1) involves the gathering of unique data on the physical characteristics of colloids, which are important ingredients in many commercial products such as paints and pharmaceuticals.
- VASCULAR, an ongoing experiment, examines the impact of long-duration space flight on inflammation of the blood vessels of astronauts, a condition that may cause atherosclerosis or increase the risk of cardiovascular disease later in life.
- Radi-N2 is an ongoing activity carried out on the ISS for the purpose of characterizing the neutron radiation field inside the ISS. The monitoring of radiation in space requires the use of techniques and technologies similar to those used for measurements on Earth. Therefore, information gained from the Radi-N2 measurements on the ISS could potentially be of use in terrestrial applications, the nuclear industry and the medical community, and in the area of national defence and security.
- Microflow technology, which enables scientists and physicians to quantify molecules and cells in blood or other body fluids, is a first step in being able to provide real-time medical care for crewmembers. This technology is used in a variety of bioanalysis and clinical applications on Earth. Successful experiments could lead to additional ground applications.

[7] This priority is from page 15 of the 2012-13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf

SE Priority #2	Type
Fostering the development of scientific instruments, advanced space robotics and other technologies capable of contributing to international space exploration missions.[8]	Ongoing

Summary of Progress

The CSA has continued to participate actively in the International Space Exploration Coordination Group (ISECG). The agencies' top priority was to draft a white paper outlining the benefits stemming from space exploration. The ISECG also focused on further developing the Global Exploration Roadmap for robotics and human exploration of the Moon, Mars and asteroids published in 2011. The CSA also worked on the transition of the Chair of the ISECG from the JAXA to the CSA, which took place early in April 2013.

Developed under the Stimulus initiative, in 2012–13, the Exploration Surface Mobility (ESM) project completed the development, tested the systems and demonstrated the rover prototypes in support of future robotic exploration of the Moon or Mars. These activities were conducted in collaboration with the industry using the CSA's facilities. A total of 19 contracts were completed in 2012–13 out of the overall 33 contracts awarded during the four year period. More than 40 companies and a dozen of universities were involved. In 2012–13, four major deployments on analogue sites were conducted.

[8] This priority is from page 15 from the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf

Program: FUTURE CANADIAN SPACE CAPACITY (FCSC)	
FCSC Priority #1	**Type**
Implement a renewed cooperation agreement with the European Space Agency (ESA). [9]	Ongoing
Summary of Progress	
The Canada–ESA Agreement was ratified in March 2012. The CSA consulted the Canadian space-related firms and academia, and relevant GoC organizations as part of the program selection process in preparation for the 2012 ESA Ministerial Council meeting. Canada announced a total investment of €18.6 million (approx. $30.4 million) by the Government of Canada in a series of ESA optional programs that support key government priorities and the Canadian industry and scientific community, as detailed below: • The ESA's Earth Observation Envelope Program (EOEP) remains the most important focus of Canada's investments, which was €11 million, representing more than half of Canada's total new contribution envelope; • Targeted contribution of €3.4 million to the ESA's Advanced Research in Telecommunications Systems (ARTES) Program; • Further investments of €3 million in the European Program for Life & Physical Sciences in Space (ELIPS) in order to secure Canadian opportunities on ESA-led microgravity research programs; • €1.0 million to the Generic Support Technology Program (GSTP) supporting important Canadian industrial interests; and • A commitment of €200,000 to the Global Monitoring for Environment and Security (GMES) Space Component with intentions to commit additional funding in 2014. To give an example of the impact of Canada's participation in ESA programs, in 2012–13 the CSA continued to support Canadian companies involved in the development of Earth observation advanced space-borne instruments and sub-systems, and user-oriented applications, as follows: • Development and successful delivery of the Electric Fields Instrument, designed to monitor the ionosphere for the SWARM mission; • Successful manufacturing and testing of the microbolometer detector in Broad-Band radiometer for the EarthCARE mission; • Development of Synthetic aperture Radar (SAR) antenna and processor for Sentinel missions, and its active calibration transponder.	
FCSC Priority #2	**Type**
Develop and use sub-orbital platforms (balloons, aircraft and sounding rockets) and small satellites to increase the pace of training and scientific discovery. [10]	Ongoing

[9] This priority is from page 17 from the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf
[10] This priority is from page 17 from the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf

Summary of Progress
In March 2013, the new stratospheric balloon launch infrastructure was completed. Located in Timmins, Ontario, this project provides access to balloon flights for the training of Canadian scientists and engineers. It also creates scientific opportunities for them, in collaboration with the French Space Agency (Centre national d'études spatiales — CNES). The first flights are scheduled in 2013–14.
An implementation agreement was signed with the CNES to establish an international collaboration in the field of stratospheric balloons and provide frequent flight opportunities for Canadian organisations in order to build capacity in the near space environment.
The CSA provided support for scientists and engineers by selecting 5 new projects to fly on sub-orbital platforms. Funding began in 2012–13 for a three-year period.

Program: INTERNAL SERVICES (IS)	
IS Priority #1	**Type**
Complete the CSA's governance review. Equally important is the strengthening of internal processes with regards to project management and performance measurement to ensure sound governance pertaining to programs and projects.[11]	Ongoing
Summary of Progress	
A roadmap identifying aspects of CSA's governance requiring additional clarifications and guidance was produced and includes the following: • The establishment of "considerations" to guide the selection of the CSA's future investments; • The application of guidelines to be followed in the preparation of business cases to support investment decision-making; • The continued implementation of the Treasury Board's (TB) Policy on Project Management with the development of a CSA-wide policy and methodology on project management; and • The implementation of the revised governance structure and an Agency-wide project management process to be completed in fiscal year 2013–14. The proposed governance structure will enhance the ongoing and evergreen development of the CSA's Investment Plan.	
IS Priority #2	**Type**
Final development and implementation of the Five-Year Investment Plan in accordance with TB policies on investment planning, assets, acquired services, and management of projects.[12]	Ongoing
Summary of Progress	
In the past year, significant progress was made in drafting and revising the CSA's Investment Plan. Further revisions are expected for a TB approval in fiscal year 2013–14.	

[11] This priority is from page 18 of the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf
[12] This priority is from page 18 of the 2012–13 RPP http://www.asc-csa.gc.ca/pdf/rpp-2012-eng.pdf

1.5 RISK ANALYSIS

ORGANIZATIONAL CONTEXT (OPERATING ENVIRONMENT)

In 2012–13, the CSA completed the implementation of a new integrated corporate risk process, derived from the 2012 CSA Policy on Integrated Risk. The new process involved the updating of the Corporate Risk Profile (CRP), in which corporate risk principles and definitions were addressed separately from project management issues.

The new CRP takes both, external and internal factors into consideration. More specifically, the CRP includes external factors that may affect the achievement of each expected program outcome of the PAA, while identifying internal factors that may preclude the efficient and effective implementation of program activities. The implementation of a renewed internal Policy on Integrated Risk provided the Agency with an opportunity to identify the key risks to be dealt with during program priorities setting and investment decision-making. The table below highlights some of the risks that are part of the CSA's renewed CRP.

The seriousness of these risks will be assessed annually in order to monitor the adequacy of measures taken to mitigate the risks that have arisen.

Risk	Risk Response Strategy	Programs Most Affected	Link to Organizational Priorities
Fiscal management The potential that costs may become greater than originally planned could reduce the amount of funds available to launch new initiatives. Increased costs could compel the CSA to reconsider priorities.	– Reduce technological uncertainty by implementing technology development activities at the design stage; – Assess projects' risks and allocate a financial risk margin based on the risks' impact and probability levels; – Monitor the implementation of a new project management policy; – Develop a new project management methodology; – Where applicable, implement acquisition strategies based on risk sharing with industry partners.	1.1.1 Earth Orbit Missions 1.2.2 Exploration Missions 1.1.2 Ground Stations 1.2.1 International Space Station	Internal Services Priority #1

Risk	Risk Response Strategy	Programs Most Affected	Link to Organizational Priorities
Space capacity New international competitors, fluctuating technological development and the uncertainty associated with technological development, may impact the long-term priorities of the CSA.	– Ongoing updating of the Canadian space technology requirements spectrum; – Promotion of partnerships between the private industry, the university community and the CSA; – Ongoing monitoring of Canadian space sector conditions; – Partnerships with foreign space agencies to expand academia and industry opportunities to participate in the development of international missions.	1.2.2 Exploration Missions 1.3.2 Market Access and Innovation 1.1.3 Space Data and Services Utilization 1.3.1 Space Expertise	Future Canadian Space Capacity Priorities #1 and #2 Space Exploration Priority #2
Gap between expectations and supply Due to possible interruptions, infrastructure challenges, personnel availability, project implementation or changes in partners' requirements and priorities, there may be a possible gap between partners' expectations and the data and services provided by the CSA.	– Ongoing consultations with GoC organizations and the university community regarding long–term requirements; – Ongoing consultations during the development phase about operational requirements; – Produce cost–effectiveness analysis to determine if small satellite development could provide fast and efficient space solutions; – Ongoing monitoring and implementation of mechanisms to optimize the allocation of RADARSAT-2 data portion of the government's credit; – Monitoring of space objects and collision–avoidance measures; – Annual updating of the Integrated Human Resources Plan.	1.1.1 Earth Orbit Missions 1.2.1 International Space Station 1.3.3 David Florida Laboratory 1.1.2 Ground Stations	Space Data Information and Services Priority #1

Risk	Risk Response Strategy	Programs Most Affected	Link to Organizational Priorities
Fiscal resource management Because of costs, higher share of funding allocation to operations, or governance, targeted funding needs to be identified to meet CSA space requirements.	– Analysis of possible synergies between available resources and equipment, and new mission options; – Reassessment of operating costs; – Search for partnerships for operating cost sharing; – Continuous monitoring of project implementation; – Regular review of the project portfolio, activity plans and schedules; – Regular review of financial management strategies; – Development of a guide to implement and monitor the investment planning policy.	1.3.2 Innovation and Market Access 1.1.1 Earth Orbit Missions 1.2.2 Exploration Missions 1.1.2 Ground Stations	Internal Services Priorities #1 and #2

1.6 SUMMARY OF PERFORMANCE

2012–13 Financial Resources ($ in millions)

Total Budgetary Expenditures (Main Estimates)	Planned Spending	Total Authorities (available for use)	Actual Spending (authorities used)	Difference (Planned vs. Actual Spending)
363.2	388.3	386.6	320.2	68.0

Any significant variance reported in relation to Planned Spending in the 2012–13 RPP is explained in Section 4.2.1 – Spending by Program.

2012–13 Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
687.0	643.5	43.5

1.6.1) Summary of Performance Tables

Strategic Outcome: "*Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information*".

($ in millions)

Program/ Alignment to Government of Canada (GoC) Outcomes	Total Budgetary Expenditures (Main Estimates 2012–13)	Planned Spending			Total Authorities (available for use) 2012–13	Actual Spending (authorities used)		
		2012–13	2013–14	2014–15		2012–13	2011–12	2010–11*
Space Data, Information and Services								
GoC Outcome: Well–managed and efficient government operations	156.2	173.7	98.7	78.4	163.7	130.8	137.3	105.8
Space Exploration								
GoC Outcome: An innovative and knowledge–based economy	100.0	106.3	93.6	93.0	108.1	87.5	146.3	138.9
Future Canadian Space Capacity								
GoC Outcome: An innovative and knowledge–base economy	63.3	63.3	70.8	70.9	63.4	52.5	69.6	72.7
Sub–Total	319.5	343.3	263.1	242.3	335.2	270.8	353.2	317.4

Note: Due to rounding, decimal points may not add up to totals shown.
*Actual Spending 2010–11 Crosswalk based on 2011–12 PAA structure.

Performance Summary for Internal Services ($ in millions)

Internal Services	Total Budgetary Expenditures (Main Estimates 2012–13)	Planned Spending			Total Authorities (available for use) 2012–13	Actual Spending (authorities used)		
		2012–13	2013–14	2014–15		2012–13	2011–12	2010–11*
	43.7	45.0	46.6	46.8	51.3	49.4	55.9	55.4
Sub–Total	43.7	45.0	46.6	46.8	51.3	49.4	55.9	55.4

*Actual Spending 2010–11 Crosswalk based on 2011–12 PAA structure.

Total Performance Summary Table ($ in millions)

Strategic Outcome(s) and Internal Services	Total Budgetary Expenditures (Main Estimates 2012–13)	Planned Spending			Total Authorities (available for use) 2012–13	Actual Spending (authorities used)		
		2012–13	2013–14	2014–15		2012–13	2011–12	2010–11*
	363.2	388.3	309.7	289.1	386.6	320.2	409.1	372.8
Total	363.2	388.3	309.7	289.1	386.6	320.2	409.1	372.8

*Actual Spending 2010–11: Crosswalk based on 2011–12 PAA structure.

For more information on Government of Canada Outcomes mentioned previously, go to: http://www.tbs-sct.gc.ca/ppg-cpr/descript-eng.aspx

1.7 EXPENDITURE PROFILE

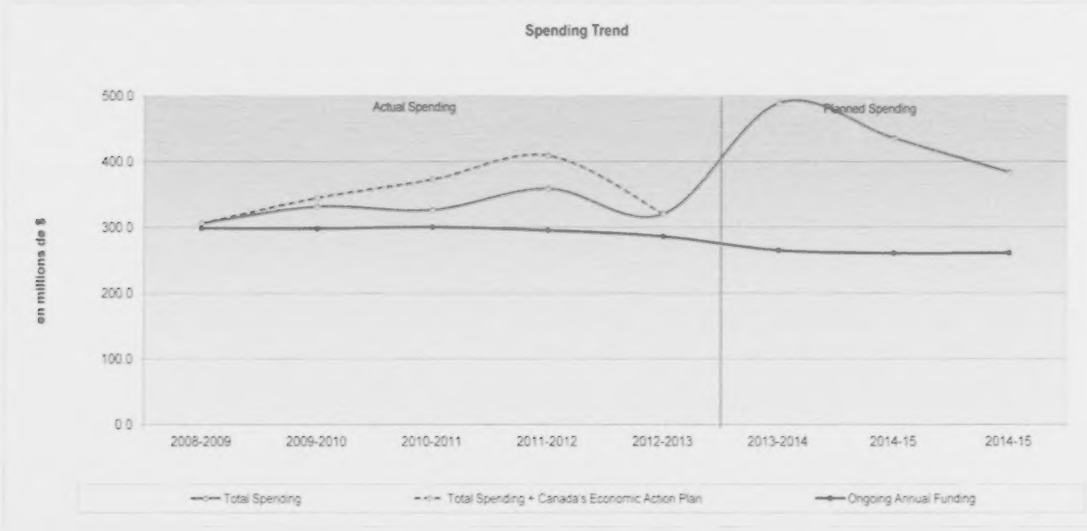
This sub–section examines the spending trend of the CSA, as illustrated in the graph below.

The red bottom line (Ongoing Annual Funding), illustrates the evolution of the CSA's ongoing annual A–Base budget.

The solid blue line (2011–12 and before for Actual Total Spending and 2012–13, and beyond for Planned Total Spending) is greater than the annual A–Base budget (Ongoing Annual Funding) because of the reprofiling of funds related to the implementation of projects and programs, as well as additional funding provided in Budget decisions for specific initiatives.

The dotted blue line (Total Spending plus Canada's Economic Action Plan funding) shows the Agency's total spending with an additional $110 million announced in the 2009 Budget.

Spending Trend



The CSA's annual A–Base budget of $300 million was set in Budget 1999, but the difference in the spending trend shown above is mainly attributable to the following factors:

- The incremental funds for the RCM following the government decision to provide the CSA with an additional $111 million over five years (2005–06 to 2009–10) to work with the Canadian space industry on developing the next generation of advanced radar remote sensing satellites.
- In Budget 2009, Canada's Economic Action Plan (Action to Support Businesses and Communities) provided the Canadian Space Agency with $110 million over three years to develop terrestrial prototypes for space robotic vehicles, such as the Mars Lander and Lunar Rover, and for the further development of other

technologies and space robotics. The Canadian Space Agency plays an important role by working with the private sector to support advanced research, development and prototyping for new space–based technologies.

- In Budget 2010, the CSA was granted the sum of $397 million over five years (2010–11 to 2014–15) to develop the RCM. Furthermore, the CSA received additional funding of $374 million over six years (2013–14 to 2018–19) and of this amount, $234.2 million comes from transfers from GoC organizations.

- On August 4, 2011, an Order in Council (OIC) established Shared Services Canada (SSC) as part of the Public Works and Government Services Canada (PWGSC) portfolio to streamline and reduce duplication in the government's Information Technology (IT) services. SSC will consolidate the resources and personnel currently supporting email, data centers and networks, and associated internal services. In 2011–12, unexpended authorities related to functions transferred to SSC corresponded to $3.5 million. Starting in 2012–13, the CSA transferred $7.2 million of its A–Base budget to SSC.

- The implementation of changes announced in Budget 2012.

- The cumulative impact of the reprofiling of funds associated with the sound management of high–risk projects and programs (e.g., high technology risks, long-term development cycle, uncertainties with work schedules, and implementation delays).

1.8 ESTIMATES BY VOTE

For information on our organizational votes and/or statutory expenditures, please see the *Public Accounts of Canada 2013 (Volume II)*[13] An electronic version of the 2-13 Public Accounts is available on the Public Works and Government Services Canada website.

1.8.1) Strategic Environmental Assessment

The CSA is subject to and complies with the Cabinet Directive on the Environmental Assessment of Policy, Plan and Program Proposals. During 2011–12, the CSA did not have any initiatives subject to this Directive.

[13] For additional information on Public Accounts, go to: http://www.tpsgc-pwgsc.gc.ca/recgen/cpc-pac/index-eng.html

SECTION 2: ANALYSIS OF PROGRAMS BY STRATEGIC OUTCOME

2.1 STRATEGIC OUTCOME

All of the CSA's Programs contribute to achieving the Agency's strategic outcome: *Canada's exploration of space, provision of space services and development of its space capacity meet the nation's needs for scientific knowledge, innovation and information.*

With the implementation of the revised PAA and Performance Measurement Framework in April 2011, new performance indicators and targets were introduced to measure the achievements of programs. With this cycle of reporting, performance measurements are being collected for a second consecutive year. In order to begin an informative trend analysis, a recommended approach to compare R&D results, a third year of data collection will be necessary.

2.2 PROGRAMS' PERFORMANCE AND LESSONS LEARNED

2.2.1) PROGRAM – 1.1. SPACE DATA, INFORMATION AND SERVICES

Description: This Program includes the provision of space–based solutions (data, information and services) and the progression of their utilization. It also serves to install and run ground infrastructure that processes the data and operates satellites. This Program utilizes space–based solutions to assist Government of Canada (GoC) organizations in delivering growing, diversified or cost–effective programs and services within their mandate, which is related to key national priorities, such as sovereignty, defence, safety and security, resource management, environmental monitoring and the North. It also provides academia with data required to perform its own research.

The services delivered through this Program are rendered, and the data and information are generated and processed, with the participation of the Canadian space industry, academia, GoC organizations, national and international organizations, such as foreign space agencies, not–for–profit organizations, as well as provincial and municipal governments. This collaborative effort is formalized under national and international partnership agreements, contracts, grants or contributions.

2012–13 Financial Resources ($ in millions)

Total Budgetary Expenditures (Main Estimates)	Planned Spending	Total Authorities (available for use)	Actual Spending (authorities used)	Difference
156.2	173.7	163.7	130.8	42.8

Due to rounding, decimal points may not add up to total shown.

Any significant variance reported in relation to Planned Spending in the 2012–13 RPP is explained in Section 4.2.1 – Spending by Program.

2012–13 Human Resources (FTEs)

Planned	Actual	Difference
107.4	95.4	12.0

Due to rounding, decimal points may not add up to total shown.

Space Data, Information and Services 2012–13 Program Performance Measurement			
EXPECTED RESULT	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
GoC organizations offer more diversified or cost–effective programs and services due to their utilization of space–based solutions.	1. Number of GoC programs and number of different themes serviced by space–based solutions.	While there was an increase in the number of programs serviced, no quantitative target was set because a strategic overview document was being developed.	34 GoC organizations programs
	2. New success stories of improved efficient/effective departmental mandate delivery due to space–based solutions.	While the number of programs serviced is monitored no quantitative target was defined.	6 instances of improved departmental mandate delivery out of 15 new success stories reported

PERFORMANCE SUMMARY AND ANALYSIS OF PROGRAM

Government of Canada organizations programs

Twelve departments are using RADARSAT-1 and –2 data and made long-term investments to develop new capabilities by either bringing applications closer to an operational status or by finding ways to improve the use of the data in order to carry out their mandate more effectively. Overall, this represents 336 GoC users and 15 research centres. The CSA continued to provide Earth observation data and strategic derived information products upon International Space and Major Disasters Charter activation.

In 2012–13, the CSA conducted a pilot project to identify the RADARSAT-2 data utilization within the PAA of each GoC organization. The results obtained by 5 GoC organizations identified the following:

11 programs in the Department of Fisheries and Ocean (DFO);
9 programs in the Department of National Defence (DND);
6 programs in Environment Canada (EC);
6 programs in Natural Resources Canada (NRCan);
2 programs in Agriculture and Agri–Food Canada (AAFC).

EC remained the largest users of SAR data, followed by DND. It should be noted that AAFC doubled its use of data in 2012–13 as it operationalizes its annual crop inventory on a national scale using RADARSAT-2 images.

Source: Internal reporting documents.

SUCCESS STORIES:

RADARSAT data provided DND with value-added information to enhance the effectiveness of operation planning and conduct of Operation Driftnet, a multi-national maritime operation that monitors illegal, unregulated and unreported fishing activity in the north-western Pacific Ocean. A slight increase of data to support oceanography, in addition to further re-use of data already collected for Maritime Domain Awareness is expected in the upcoming years.

NRCan and the Parks Canada Agency, in collaboration with the Canadian Earth observation (EO) value-added industry, are setting up an operational satellite-based system to monitor environmental changes in northern National Parks (238,800 km² or 85% of the area of all National Parks). The RADARSAT-2 data are used for reporting on the ecological integrity of the parks and contribute to better land management.

The Canadian International Development Agency (CIDA) provided support for the first phase of the Arghandab River irrigation system rehabilitation project in Kandahar Province in Afghanistan. Change detection techniques, developed by the Canadian EO value-added industry and, based on RADARSAT-2 images to map and quantify changes in increased land-use for agriculture in Afghanistan, are helping the CIDA demonstrate quantitatively the positive value of Canada's investment in the rehabilitating of irrigation systems to improve water distribution in developing countries.

AAFC and the Canadian agricultural sector are integrating remote sensing data into selected models to improve the monitoring of drought, crop health, soil moisture and land uses. The RADARSAT-2 data are being utilized in several subsystems to enhance operational decision support. The national-scale data production and derived applications are important contributions to global food security related research, development and decision making.

Source: EO-Express Newsletter[14]

LESSONS LEARNED

An action plan was implemented in response to the recommendations of an internal evaluation of the Earth Observation Data and Imagery Utilization Program released in June 2011. The evaluation concluded that some improvements could be made to maximize the use of resources to achieve the expected outcomes. As a result of this evaluation, the CSA is currently reviewing its selection criteria for government-related projects in order to increase industry participation in the development of applications.

[14] The EO-Express Newsletter is available at:
http://www.asc-csa.gc.ca/eng/newsletters/eo-express/default.asp

Sub–Program: 1.1.1. Earth Orbit Satellite Missions and Technology

Description: This SP encompasses the development of complete Canadian satellite systems or of sub–systems, payloads, instruments or other components provided to domestic and foreign satellites. The SP also includes the development of advanced technologies that could shape or determine the nature of potential new Earth orbit satellite missions. This SP fosters GoC to use satellite–generated data, information and services to deliver their mandate; and so do academia to perform their research.

This SP is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

2012–13 Program Performance Measurement

EXPECTED RESULT #1	PERFORMANCE INDICATORS	TARGETS	ACTUAL RESULTS
GoC organizations expressed needs for space-based solutions are fulfilled by CSA.	1. Ratio of requests from GoC organizations vs. CSA response through missions, instruments and/or partnerships.	Benchmark to be established.	**Benchmark set:** 68.05% for RADARSAT-2, 87.7% for RADARSAT-1 and 97% for SciSat.
	2. Numbers of needs (by theme) linked to Sun–Earth System Science fulfilled by the CSA through missions, instruments and/or partnerships.	Benchmark to be established.	**Benchmark set:** 6 needs: Space Weather, Ozone Layer, Air Pollution, Clouds, Fire and Soil Moisture.

Performance Summary and Analysis of Sub–Program

Expected Result #1 – These indicators are new and no targets were set for 2012–13.

Indicator 1

The percentage calculation is based on the ratio of acquisition requests met per mission requirements.

The CSA continue to manage $445.95 million of prepaid RADARSAT-2 data allocation and continued to respond to the RADARSAT-1 data request, thus ensuring that the needs for EO data by government users are met in a sustainable way.

In 2012–13 both European ENVISAT and Canadian RADARSAT-1 satellites ceased to operate. They were instrumental in terms of improving coverage of users' areas of interest, reducing latencies, providing complementary data/modes, and alleviating potential data acquisition conflicts with RADARSAT-2.

In support for the growing demand of data by the Canadian government and to reduce the number of data acquisition conflicts, the CSA is taking the lead to negotiate an agreement with the European Space Agency to secure access to Sentinel satellites. This additional source of data will help to extend the length of the RADARSAT-2 data government allocation until the launch of RCM.

CSA also finalized the manufacturing of the M3MSat Satellite and initiated the assembly, integration and testing at the DFL facility. M3MSat, to be launched in 2013, will allow optimization of the AIS payload in maritime traffic identification in response to expressed needs by GoC organizations.

The design of RCM, which was a CSA priority, was completed in November 2012 and a contract was awarded for the follow–on implementation phase. Consequently, the CSA continues to make significant progress in ensuring Earth observation data continuity.

Indicator 2

With seven missions in operations (SCISAT, MOPITT, OSIRIS, CGSM, THEMIS, NIRST and CloudSat), CSA continued to fulfill a variety of user needs in the Sun–Earth System Science. In order to ensure continuity in those fields, CSA pursued the development of five instruments or missions among which three will be launched in the near future (CASSIOPE [2013], SWARM [2013] and SMAP [2014]).

Source: Internal documents.

SSPs Overall Achievements vs. Planned Targets

In 2012–13, the targets for 4 of the 5 indicators were met. 1 target was partially met in SSP 1.1.1.1Earth Observation Missions.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
146.2	105.4	40.8

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
68.5	61.3	7.2

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into three Sub-Sub-Programs:

1. ***Sub-Sub-Program 1.1.1.1. Earth Observation Missions***

Description: This SSP encompasses the definition, design, technology development, and implementation of Earth orbit satellites dedicated to producing data, information or imagery of Earth and its atmosphere, ranging from its sub–surface to its upper atmospheric layers, including space surveillance for asteroids, earth orbiting objects and space debris. This SSP serves continuous operations and fosters pertinent Earth observation to produce data and imagery that assist with the mandate delivery of Government of Canada (GoC) organizations that deal especially with key national priorities, such as environment, climate change, weather, natural resources, sovereignty, defence, safety and security. It also provides academia with data required for its research.

This SSP is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

Maximized access to Canadian and foreign EO data.	
Indicator	**Performance**
1. Number of EO missions/instruments in development and projected capacity of data availability to GoC organizations. (Target: 1 mission in phase BCD (development): RCM. Projected capacity: Benchmarking).	**Target met:** The RCM is now in the manufacturing and assembly phase. It is the only mission at this point.
Additional Information Source: Internal reporting documents.	

Indicator	Performance
2. Number of EO missions/instruments in operation, number of partnerships signed and current capacity of data availability to GoC organizations. (Target: 4 missions in phase E [ERS2, RADARSAT-1, RADARSAT-2, ENVISAT ASAR and ENVISAT MERIS]. Current capacity : Benchmarking).	**Target partially met:** RADARSAT-1 and RADARSAT-2 only. ERS–2 is decommissioned since 2011. The ESA lost contact with ENVISAT on April 8, 2012.
Additional information Two missions were in operation, RADARSAT-1 and RADARSAT-2. Following 16 years of Earth observations, the European Space Agency's ERS–2 satellite was decommissioned and removed from its continuous orbit around the Earth on July 4, 2011. For Envisat, no data was used as ESA lost contact with the satellite on 8 April 2012. ESA formally announced the end of mission Envisat on 9 May 2012. RADARSAT-1 experienced a major technical anomaly on March 29, 2013 and subsequently was declared no longer operational on May 9, 2013. Source: Internal reporting documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
137.9	98.9	39.0

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
47.8	36.4	11.3

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.1.1.2. Communications Missions*

Description: This SSP encompasses the definition, design, technology development, and implementation of Earth orbit satellites dedicated to delivering continuous communications, including Navigation, Positioning and Timing (NPT) services. This SSP serves continuous operations and fosters pertinent communications and NPT to provide services that assist GoC organizations in the delivery of their mandate, particularly those locating and monitoring vehicle or ship signals, those dealing with remote communities or those managing other key national priorities, such as sovereignty, defence, safety and security.

This SSP is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

Maximized access to Canadian and foreign satellite communications data and services.

Indicator	Performance
1. Number of satellite communications missions/instruments in development and projected capacity of data and services availability to GoC organizations. (Target: 2 [CASSIOPE/ M3MSAT]. Projected capacity : Benchmarking).	**Target met:** 2 missions (CASSIOPE and M3MSat) development phase.
Additional Information CASSIOPE: A mission that will demonstrate both the small satellite bus capability and the future space-based digital courier system CASCADE. M3MSat: This joint CSA–DND micro–satellite project will demonstrate and further develop a multi–mission micro–satellite bus capability and, establish micro–satellites as operationally cost effective Source: Internal reporting documents and www.asc-csa.gc.ca	
Indicator	**Performance**
2. Number of missions/instruments in operation, number of partnerships signed and current capacity of data and services availability to GoC organizations. (Target: 1 [Anik–F2]. Current capacity: Benchmarking).	**Target met:** 1 mission (Anik–F2).

Additional Information

Anik F2 is Telesat Canada's innovative, high-speed Ka-band, multimedia telecommunications satellite. Positioned in geostationary orbit, Anik F2 is optimized for a wide range of leading-edge telecommunications services. Thanks to its innovative Ka-band technology, low-cost, two-way satellite delivery is available for wireless broadband Internet connections, tele-medicine, tele-teaching, tele-working and e-commerce in the most remote regions of Canada.

Source: www.asc-csa.gc.ca

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
5.9	3.3	2.6

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
11.8	18.6	(6.8)

Due to rounding, decimal points may not add up to total shown.

3. *Sub-Sub-Program 1.1.1.3. Scientific Missions*

Description: This SSP encompasses the definition, design, technology development, and implementation of Earth orbit satellites dedicated to producing scientific data and information for research performed by GoC organizations or academia. Examples of this research are those pertaining to climate processes and space weather (solar winds and their interaction with the Earth's magnetic field). This SSP fosters pertinent scientific to produce data and information that allow GoC organizations to mitigate damage or avoid the disabling of critical ground and space infrastructure, such as pipelines, electricity networks and satellites that can sustain damage from the effects of solar winds. In addition, with their enhanced understanding of climate processes and the improved models made possible through this SSP, GoC organizations are better able to provide weather and climate forecasting. Academia also uses the data and information produced through this SSP to perform its own research.

This SSP is delivered in collaboration with GoC organizations, along with the participation of Canadian industry, academia and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

Maximized access to Canadian and foreign Solar and Earth System Sciences data.

Indicator	Performance
1. Number of Solar and Earth System Sciences missions/instruments in development and projected capacity of data availability to GoC organizations. (Target: 2: [SMAP, Swarm]. Projected capacity: Benchmarking).	**Target exceeded:** 3 missions.

Additional Information

SWOT = Surface Water and Ocean Topography. This mission will allow the measurement of lake levels and ocean circulation features and will be of great utility to Environment Canada for hydrological and meteorological monitoring and forecasting, and to Fisheries and Oceans Canada for ocean science and forecasting.

Swarm = The Swarm mission will study the geomagnetic field evolution with precision, using a fleet of three satellites orbiting in the ionosphere.

SMAP = Soil Moisture Active and Passive. SMAP data will improve the representation of energy, water and carbon cycles in Canadian environmental analysis and prediction systems using soil moisture and freeze/thaw data.

Source: Internal reporting documents and www.asc-csa.gc.ca

Indicator	Performance
2. Number of Solar and Earth System Sciences missions/instruments in operation, number of partnerships signed and current capacity of data availability to GoC organizations. (Target: 6: [SCISAT, MOPITT, OSIRIS, CGSM, THEMIS and NIRST]. Current capacity: Benchmarking).	**Target exceeded:** 7 missions in operation.

Additional Information

SciSat = Space Science Satellite. This satellite helps a team of Canadian and international scientists improve their understanding of the depletion of the ozone layer, with a special emphasis on the changes occurring over Canada and in the Arctic.

MOPITT = Measurements of pollution in the troposphere. This instrument, on NASA's Terra satellite, measures pollutants in the troposphere, providing a wealth of data on global transport of pollutants.

OSIRIS = Optical Spectrograph and InfraRed Imaging System. This instrument, on NASA's Terra satellite, measures ozone in the stratosphere and mesosphere and provides important data to assess and predict the health of the ozone layer.

CloudSat = This satellite is conducting the first comprehensive three-dimensional study of clouds. It gathers data on their structure, frequency and volume, and helps improve our understanding of how they influence the weather. It uses a radar hyperfrequency device to probe the cloud cover and determine its thickness, its altitude at base and peak, and the quantity of water and ice contained. CloudSat was developed by NASA in partnership with the Canadian Space Agency.

CGSM = Canadian Geospace Monitoring. CGSM is a coordinated observation, data assimilation, and modeling program. Its observational program employs an integrated continent-scale array of radio, magnetic, and optical instruments. It will enable Canadian scientists to lead international efforts to answer fundamental questions in solar-terrestrial physics

THEMIS = Time History of Events and Macroscale Interactions during Substorms. This NASA mission investigates what causes auroras in the Earth's atmosphere to dramatically change from slowly shimmering waves of light to wildly shifting streaks of color. Discovering what causes auroras to change will provide scientists with important details on how the planet's magnetosphere works and the important Sun–Earth connection.

NIRST = New Infrared Sensor Technology Radiometer. The primary purpose of NIRST is to monitor the extent and retrieve the temperatures of forest fires and other high temperature events.

Source: Internal reporting documents, www.asc-csa.gc.ca, www.nasa.gov and www.cgsm.ca

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
2.4	3.3	(0.9)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
8.9	6.3	2.6

Due to rounding, decimal points may not add up to total shown.

Sub–Program: 1.1.2. Ground Infrastructure

Description: This SP includes the development, installation and use of an integrated and coordinated national system of ground infrastructure to receive data from domestic or foreign satellites. In addition, the ground infrastructure houses and uses the equipment required for satellite operations. This SP fosters satellites to operate as well as to process and make available space–based data received by the Canadian Space Agency to assist GoC organizations in delivering their mandate. Finally, this SP capitalizes on Canada's geographical advantage by capturing space data from the increasing number of satellites flying over the Arctic and by installing ground stations in this strategic location.

This SP is delivered with the participation of industry, GoC organizations and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
Expressed Canadian and foreign data needs are fulfilled by ground infrastructure.	Volume of response to data requests fulfilled by ground infrastructure operations.	SciSat–1= 750 Gbytes; RADARSAT-1= 4000 Synthetic Aperture Radar (SAR) minutes; RADARSAT-2 = 7,500 frames.	**Target exceeded:** 1,706 Gbytes of SciSat–1; 14560 SAR minutes of RADARSAT-1, and 25,926 frames of RADARSAT-2.
EXPECTED RESULT #2			
National ground infrastructure is reliable.	Percentage of reliability.	85% for RADARSAT 1 and SciSat-1.	**Target met:** 94.4% for RADARSAT-1; 95% for SciSat-1.

Performance Summary and Analysis of Sub–Program

Expected Result #1

Indicator 1

In 2012–13 demand for SciSat-1data increased and was delivered satisfactorily. Last year's demand was 750 Gbytes for SciSat–1. Demand for RADARSAT-1 and 2 data continued to grow. Last year, GoC users requested 7,437 scenes from RADARSAT-1 to be processed and have ordered 30,172 scenes from RADARSAT-2.

The CSA reports monthly on the use of RADARSAT-2 credits. When demand exceeds planned requests by 20%, an investigation is conducted with the user to more clearly define needs and mitigate conflicts. Activities are also carried out to raise awareness, both of the impact of the use of data on our credit consumption and of the impact of urgent requests on service costs. Costs related to higher priority services have been reduced by 5.2 % from 2011–12 to 2012–13.

In the context of the midterm review of RADARSAT-2 operation, the CSA conducted a survey among GoC users to obtain feedback. In general, the results were positive and surveyed users were satisfied with the services provided by the CSA through the order desk and other program activities. Nevertheless, some concerns were raised, such as the issues of limited data sharing and acquisition conflicts between users. An action plan was drawn up to assess the implementation of future improvements.

The CSA also continued to support scientific data acquisition through the operations of Canadian instruments onboard CloudSat, Mopitt, Osiris and Nirst foreign missions as well as Themis and Geospace Monitoring ground-based instruments and observatories.

Source: Internal reporting documents.

Expected Result #2

In 2012–13, the percentage of reliability decreased, compared with the previous year's percentage of reliability of 98.2% for RADARSAT-1 and 99% for SciSat–1. Ground Infrastructure is still reliable even though it is approaching the end of its service life. Work is in progress to start using new Canada Centre for Remote Sensing (CCRS) ground infrastructure within the next two years.

Source: Internal reporting documents.

SSPs Overall Achievements vs. Planned Targets

In 2012–13, the targets for 6 of the 6 indicators were met.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
15.5	14.3	1.1

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
25.6	24.3	1.3

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into two Sub-Sub-Programs:

1. ***Sub-Sub-Program 1.1.2.1. Satellite Operations***

Description: This SSP encompasses the Telemetry, Tracking and Command (TT&C) of Canadian satellites or of foreign satellites when such services are required from Canadian stations. It also includes the development, installation and use of ground infrastructure that processes the data and operates satellites. This SSP fosters orbiting satellites functional to render.

The operations of CSA satellites are mostly conducted with CSA equipment located in Canada. In some instances, formal arrangements can be concluded between CSA, Canadian industry, GoC organizations or international partners to operate one party's satellites using another party's equipment. Those arrangements can also provide for the location of one party's equipment in another party's facilities.

EXPECTED RESULT #1

CSA's satellites are functioning as per operational requirements.

Indicator	Performance
1. Number of satellite anomalies successfully handled during flight operation maintaining satellite health. (Target: Satellite system availability maintained better than 85% by successfully resolving anomalies).	**Target exceeded:** 100 % of anomalies were resolved for SciSat-1and so were those prior to March 29, 2013 for RADARSAT-1.

Additional Information

A satellite anomaly is defined as a non-nominal event resulting in malfunctions on the spacecraft. In most cases, these malfunctions do not affect operations or services, but occasionally they can have serious consequences leading to interruptions to service, component failure or in extreme events the total loss of the satellite. Throughout 2012–13, all RADARSAT-1 anomalies were investigated and resolved. However, on March 29, 2013, a critical system failed and the satellite ceased to operate on May 9, 2013, after having operated for 12 years beyond its designated operational life span.

Source: Internal reporting documents.

Indicator	Performance
2. Number of Canadian satellites operated by the CSA as per operational requirements. (Target: Two operating satellites, i.e., SciSat-1, RADARSAT-1 and one new satellite NEOSSat).	**Target met:** 3 satellites operated by the CSA.
Additional Information SciSat-1and RADARSAT-1 continued nominal operations. NEOSSat = Near Earth Object Surveillance Satellite. This satellite is a microsatellite jointly sponsored by the CSA and Defence Research and Development Canada (DRDC) to acquire useful metric (position/time) data on Near Earth–orbiting objects (asteroids) and man–made objects (spacecraft and space debris). NEOSSat Launch and Early Orbit Phase (LEOP) were undertaken. Source: Internal reporting documents and www.asc-csa.gc.ca	

EXPECTED RESULT #2

Foreign satellite missions are supported.

Indicator	Performance
1. Number of ground station support contracts provided to foreign satellite missions. (Target: At least one foreign mission supported through 10 ground station contracts).	**Target met:** 1 supported mission PLEIADES–1B Launch and Early Orbit Phase (LEOP) support.
Additional Information One mission support for a total of 22 contracts. PLEIADES–1B = The Pleiades system is an European optical observation system with a metric resolution designed to offer a high acquisition capability with a revisit lower than 24 hours to satisfy both civilian and military needs. Source: Internal reporting documents and http://smsc.cnes.fr/PLEIADES/	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
10.7	7.9	2.8

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
24.5	21.1	3.4

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.1.2.2. Data Handling*

Description: This SSP includes a coordinated national approach to determine optimal station locations and space data handling. This SSP fosters the planning and tasking of data acquisition, as well as the capture, calibration, cataloguing, archiving and availability of space data received from domestic or foreign satellites to assist GoC organizations in delivering their mandate.

Data handling operations are mostly conducted with CSA equipment, located in its ground facilities. In some instances, formal arrangements can be concluded between CSA, GoC organizations or international partners to use another party's equipment located within its facilities. This SSP is delivered with the participation of Canadian industry, foreign space agencies and GoC organizations. This collaborative effort is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

Satellite data provided as per data requirements.

Indicator	Performance
1. Volume of data from various missions delivered to GoC organizations and other customers. (Target: 150 Gbytes from SCISAT–1; 4 000 minutes from RADARSAT-1; 15 000 frames from RADARSAT-2).	**Target exceeded:** 1,706 Gbytes of SciSat-1data; 14,560 minutes of RADARSAT-1; 25,926 frames of RADARSAT-2.

Additional Information

Measurement of data volume is as follows:

SciSat-1data volume is measured in Gbytes;

RADARSAT-1 data volume is equivalent to SAR on–time minutes; and

RADARSAT-2 data volume is measured in number of scenes.

Minutes of RADARSAT-1 acquired for GoC and other clients. Frames from RADARSAT-2 delivered to GoC clients.

Source: Internal reporting documents.

Indicator	Performance
2. Volume of data archived. (Target: 150 Gbytes from SciSat-1; 4 000 minutes from RADARSAT-1; 10 000 frames from RADARSAT-2).	**Target exceeded:** 1,706 Gbytes of SciSat-1 data; 14,560 minutes of RADARSAT-1; 25,926 frames of RADARSAT-2.
Additional Information Measurement of data volume is as follows: SciSat-1data volume is measured in Gbytes; RADARSAT-1 data volume is equivalent to SAR on-time minutes; and RADARSAT-2 data volume is measured in number of scenes. Source: Internal reporting documents.	
Indicator	**Performance**
3. Number of different satellites from which data is received. (Target: Four satellites, i.e., RADARSAT-1, SciSat-1, RADARSAT-2 and NEOSSat).	**Target met:** 3 Satellites RADARSAT-1 and 2, SciSat-1plus NEOSSAT—Launch and Early Orbit Phase (LEOP).
Additional information Source: Internal documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
4.8	6.4	(1.7)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
1.1	3.2	(2.1)

Due to rounding, decimal points may not add up to total shown.

Sub–Program: 1.1.3. Space Data, Imagery and Services Utilization Development

Description: This SP develops utilization of space–based data, imagery and information, and of communications services available on space assets for the benefit of the user community, primarily GoC organizations and academia. This SP fosters the development of a Canadian value–added industry that turns space data and information into readily useable products, as well as to increase the ability of GoC organizations to use space–based solutions (data, information and services) for the delivery of their mandate and to increase the ability of academia to perform their research.

This SP engages the participation of the Canadian space industry and academia and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
The ability of GoC organizations to use space–based solutions is enhanced.	1. Number of GoC organizations using space-based solutions.	Estimated benchmarks: Earth observation = 9; Satellite communications = 1; Science = benchmark to be established.	**Benchmarks set:** Earth observation = 10; Satellite communications = 7; Science = 6.
	2. Volume of space-based solutions available /requested.	Earth observation = 45000 acquisitions; Satellite communications = 150 days.	**Target partially met:** Earth observation = 37,609 acquisitions for RADARSAT-1 and -2; Satellite communications 500 days of data capture (S-AIS).
	3. Number of peer–reviewed papers related to data utilization produced in academia and the R&D community in Canada.	200	**Target exceeded:** 277 peer-reviewed publications and books (135 on Earth System, 142 on Solar–Terrestrial).

Performance Summary and Analysis of Sub–Program

Expected Result #1 Indicator 1 and 2 are new.

Indicator 1

Currently, 18 GoC organizations are using space-based solutions. The list of organizations is shown at the Sub-Sub-Program level.

Overall, the CSA undertook 86 projects whose objectives were to develop space-based solutions in Earth observation (EO), satellite communications, and scientific fields. These projects included the following:

- The development of EO applications, such as surface deformation surveillance for steam release to ensure that in–situ bitumen extraction in the Alberta oil sands is carried out safely and the monitoring of infrastructure vulnerability to changing permafrost affecting northern communities;
- The requirements for future cloud and precipitation radars systems;
- Satellite communications applications to ensure better use of Automated Identification System capabilities onboard the RCM, and;
- The fire information products to be derived from radiance measurements made by the New Infrared Sensor Technology (NIRST) scientific instrument.

The CSA began chairing the Committee on Earth Observation Satellites (CEOS) in November 2012. For the following year, Canada provided guidance for this international body set up to improve international coordination between EO programs and the maximum utilization of EO data, and increase collaboration among national and international stakeholders.

The CSA Earth observation Data and Image Utilization program has begun to address many action items associated with the recommendations set out in the 2012 internal evaluation report. For example, a governance procedure to catalogue user needs has been implemented to identify development clusters and coordinate partner contributions. Mechanisms have also been established to enhance the role of industry and academia's role in the development of applications. An interdepartmental committee is being formed to coordinate the needs, priorities and commitments, and to ensure that industry plays a greater role in the development of applications. Finally, a grant & contribution procedure is operational and awaiting funding.

Source: Internal reporting documents.

Indicator 2

RADARSAT-1: 7,437 scenes processed.

RADARSAT-2: 30,172 scenes deducted from the GoC data credit.

Source: Internal Credit Consumption Report.

Indicator 3

Last year's number was 301 (82 Earth System, 219 Solar–Terrestrial). The 277 publications do not include publications issued from data provided under the Science and Operational Applications Research for RADARSAT-2 Program (SOAR).

Source: Internal reporting documents.

SSPs Overall Achievements vs. Planned Targets

In 2012–13, the targets for 4 of the 6 indicators were met. 2 targets were partially met in SSP 1.1.3.1 Earth Observation Data and Imagery Utilization.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
12.0	11.1	1.0

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
13.3	9.8	3.5

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into three Sub-Sub-Programs:

1. ***Sub-Sub-Program 1.1.3.1. Earth Observation Data and Imagery Utilization***

Description: This SSP develops the utilization of Earth observation imagery and atmospheric data acquired from Canadian and foreign space assets, ranging from its sub–surface to its upper atmospheric layers. This also applies to weather and climate imagery. This SSP fosters the applicability of currently available Earth observation space products and services (optimization) to broaden or to create new ones (innovation) for the user community (GoC organizations and academia).

This SSP engages the participation of the Canadian space industry and academia and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

The ability of GoC organizations to covert EO data into useable products is enhanced.

Indicator	Performance
1. Number of Earth observation data utilization development activities supported. (Target : 20 for the Government-Related Initiatives Program [GRIP]).	**Target partially met:** 17 projects were supported with GOC organizations.

Additional Information

GoC organizations participating in utilization activities are: Agriculture and Agri–Food Canada (AAFC), Aboriginal Affairs and Northern Development Canada (AANDC), Canadian Nuclear Safety Commission (CNSC), Fisheries and Oceans Canada (DFO), Department of National Defence (DND), Environment Canada (EC), Natural Resources Canada (NRCan), Parks Canada (PC), Public Safety Canada (PSC), and Canadian International Development Agency (CIDA).

Projects supported jointly with GoC organizations helped to improve or advance the integration and use of EO data, particularly those from RADARSAT, in key activities that contribute to the delivery of their respective mandates. The business areas mainly concern the monitoring of terrestrial natural resources and the supervision and monitoring of the North, marine and coastal areas.

Source: Internal reporting documents and EO-Express Newsletter[15]

EXPECTED RESULT #2

The ability of the scientific community to conduct high–level research with EO data is enhanced.

Indicator	Performance
1. Number of Earth observation data utilization development activities supported. (Target: 200 for Science and Operational Applications Research [SOAR]).	**Target partially met**: 185 ongoing projects.

[15] The EO-Express Newsletter is available at:
http://www.asc-csa.gc.ca/eng/newsletters/eo-express/default.asp

Additional Information

Support was provided as follows for 185 ongoing projects through 7 SOAR initiatives:

International: This initiative is intended for researchers in the international education community. The CSA and MDA Geospatial Services Inc. are joining forces to boost the scientific use of data generated by the RADARSAT-2 EO satellite.

Education: This initiative, expected to continue for the lifetime of the RADARSAT-2 satellite is intended for Canadian educational organizations and research centres in order to support the scientific development of RADARSAT-2 applications and promote the use of synthetic aperture radar (SAR) remote sensing to graduate students.

Europe: This initiative conducted jointly by the Canadian Space Agency (CSA) and the European Space Agency (ESA) intend to stimulate the scientific utilization of Earth observation data by providing access to imagery acquired from RADARSAT-2 in conjunction with ERS, ENVISAT and other ESA Missions.

DLR–Germany: This initiative conducted jointly by the Canadian Space Agency (CSA) and the German Aerospace Centre (DLR) is intended to boost the scientific utilization of EO data by providing access to imagery acquired by their respective national missions: RADARSAT-2 and TerraSAR–X.

Africa: This objective of this initiative, expected to continue for the lifetime of the RADARSAT-2 satellite and, intended for researchers in organizations in Africa, is to generate benefits for Africans through the development, implementation and use of RADARSAT-2 data for new applications or to enhance existing applications targeting economic development and social, environmental, political and scientific issues.

JECAM–Agriculture: The objective of the Joint Experiment for Crop Assessment and Monitoring (JECAM), an initiative set up by the GEO Agriculture Monitoring Community of Practice, is to increase international collaboration in the area of agricultural monitoring with a view to developing a "system of systems" to address issues associated with food security and a sustainable, profitable agricultural sector worldwide.

Provinces/Territories: The objective of this initiative, expected to continue for the lifetime of the RADARSAT-2 satellite and, intended for Canadian provincial and territorial organizations, is to provide support for scientists in the development of applications using RADARSAT-2 data and to promote the use of synthetic aperture radar (SAR) remote sensing. The initiative support projects undertaken to maintain and/or improve current applications that meet specific provincial and territorial needs, develop new applications or carry out applied research on SAR data within this context.

Source: Internal reporting documents and www.asc-csa.gc.ca

EXPECTED RESULT #3	
The ability of Canadian industrial firms to convert Earth observation data into useable products is enhanced.	
Indicator	**Performance**
1. Number of EO data utilization development activities supported. (Target: 20 for the Earth Observation Application Development Program [EOADP]).	**Target exceeded**: 22 projects.
Additional information 22 EOADP contracts were awarded to industrial firms in 2012–13. In response to Canadian federal government water sector user organization requirements, a request for proposal (RFP) was issued for the development of spaceborne EO solutions. In order to maximize the options and results, a multisensor approach was adopted. The projects benefited the Canadian water sector in the following areas: hydrology, watershed management, wetlands management, flood disaster management, and coastal zone management. In support of Canadian government priorities, another RFP was issued in late 2012–13 to take advantage of image quality improvements and new methods made possible by the new imaging and operational configurations of satellites and the integration of complementary data from international imaging satellite sources. This initiative focuses on the development of advanced RADARSAT-based products and services. Source: Internal reporting documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
10.0	9.4	0.7

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
11.4	7.7	3.8

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.1.3.2. Communications Services Utilization*

Description: This SSP develops the utilization of space communications, including Navigation, Positioning and Timing (NPT) services available through Canadian and foreign satellites. This SSP fosters the applicability of currently available communications services (optimization) to broaden or to create new ones (innovation) for GoC organizations.

This SSP engages the participation of the Canadian space industry and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

The ability of GoC organizations to convert satellite communications data and services into useable products is enhanced.

Indicator	Performance
1. Number of Satellite communications data and services utilization development activities supported. (Target: 0 = Activity under review).	**Target exceeded:** 2 activities.

Additional Information

The following GoC organizations participate in utilization activities: Department of National Defence (DND), Defence Research and Development Canada (DRDC), Royal Canadian Mounted Police (RCMP), Canadian Border Services Agency (CBSA), Fisheries and Oceans Canada (DFO), Canadian Coast Guard (CCG) and Transport Canada (TC).

The following two activities are supported by the development of uses for telecommunications satellites data and services:

1. Detection of icebergs in the Atlantic; and
2. Tracing of the sources of oil spills and waste from ocean-going ships.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
1.7	1.3*	0.3

Due to rounding, decimal points may not add up to total shown.
* This amount includes expenditures for licence spectrum management contracts, data acquisition and application development.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
1.8	2.0	(0.2)

Due to rounding, decimal points may not add up to total shown.

3. *Sub-Sub-Program 1.1.3.3. Scientific Data Utilization*

Description: This SSP develops the utilization and validates the quality of Canadian and foreign space–based scientific data and derived information that address science questions, such as those related to our understanding of the Earth's climate system and magnetic field (magnetosphere). This SSP involves the collaboration of Canadian scientists from GoC organizations and academia. This SSP fosters the applicability of currently available space scientific data (optimization) to broaden or to create new ones (innovation) for GoC organizations and academia, especially in weather forecasts, climate change and space weather.

This SSP engages the participation of the Canadian space industry, academia and GoC organizations scientists, and is formalized under contracts, grants, contributions and partnership agreements with national, public/private and international organizations.

EXPECTED RESULT #1

The ability of GoC organizations to convert solar and earth system sciences data into useable products is enhanced.

Indicator	Performance
1. Number of solar and earth system Sciences data utilization development activities supported. (Target : 6 [3 Solar–Terrestrial/3 Atmospheric]).	**Target exceeded:** 7 data utilization development activities with GoC organizations were supported in 2012–13.

Additional Information

The following GoC organizations participate in scientific utilization activities:

1– National Research Council (NRC): NRC Airborne W and X–Band (NAWX) Polarimetric Doppler Radar System, a state–of–the–art dual frequency airborne radar system for atmospheric and flight safety research. http://www.nawx.nrc.gc.ca/nawx.html

2– NRC: — Space Weather — The Canadian Space Weather Forecast Centre is a Regional Warning Centre (RWC) of the International Space Environment Service (ISES). The ISES global network monitors a variety of parameters that help to characterize the conditions on the Sun, in space between the Sun and the Earth, and on the Earth. http://www.spaceweather.ca/

3– Natural Resources Canada (NRCan): NIRST = New Infrared Sensor Technology Radiometer. The primary purpose of NIRST is to monitor the extent and retrieve the temperatures of forest fires and other high temperature events.

4– NRCan–ESS: Space Weather.

5– Environment Canada: Carbon Assimilation System; this activity will allow Environment Canada, in collaboration with Canadian university scientists, to develop the capacity and assess the operational feasibility of using space borne atmospheric CO_2 observations and a transport model to infer surface fluxes.

6– Environment Canada: SMAP. The NASA's Soil Moisture Active and Passive (SMAP) mission will measure soil moisture and surface freeze/thaw with the accuracy, resolution, and coverage that are required to further our understanding of the Earth's water, energy, and carbon cycles.

7– National Sciences and Engineering Research Council (NSERC): ePOP = enhanced Polar Outflow Probe. The ePOP probe will observe the Earth's ionosphere, where space meets the upper atmosphere. It will collect data about the effects of solar storms and, more specifically, their harmful impact on radio communications, satellite navigation and other space- and ground–based technologies.

Source: Internal reporting documents and www.asc–csa.gc.ca

EXPECTED RESULT #2

The ability of the scientific community to perform high–level research with solar and Earth system sciences data is enhanced.

Indicator	Performance
1. Number of solar and Earth system sciences data utilization development activities supported. (Target: 26 [14 Solar–Terrestrial/12 Atmospheric]).	**Target exceeded:** 38 (18 solar–terrestrial, 20 earth system) data utilization development activities were supported.

Additional Information

These include all MOUs with GoC organizations and contracts and grants with universities involving data from missions in development and in operation:

Solar-Terrestrial: 2 x CGSM MOUs, 12 x CGSM contracts, 2 x THEMIS contracts, 1 x ePOP contract, 1 x Swarm contract.

Earth System: 1 x carbon assimilation system MOU, 2 carbon grants, 1 x SMAP MOU, 5 x SMAP grants, 2 x SCISAT contracts, 1 ACE arctic val grant, 1 x MOPITT contract, 3 x OSIRIS contracts, 1x NIRST MOU, 1x NIRST contract, 1x WINDII grant, 1x World Climate Research Program (WCRP) grant.

WINDII = Wind Imaging Interferometer. Its primary objective is the measurement of winds and temperatures in the upper mesosphere and lower thermosphere.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
0.3	0.4	(0.0)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
0.1	0.2	(0.1)

Due to rounding, decimal points may not add up to total shown.

Planning and Reporting Continuity
RPP 2012-2013 and DPR 2011-2012:
http://www.asc-csa.gc.ca/eng/publications/rp.asp

To learn more about Earth observation, go to:
http://www.asc-csa.gc.ca/eng/satellites/default.asp

To learn more about satellite communications, go to:
http://www.asc-csa.gc.ca/eng/satellites/default.asp

2.2.2) PROGRAM – 1.2. SPACE EXPLORATION

Description: This Program provides valuable Canadian science, signature technologies and qualified astronauts for international space exploration endeavours. This Program contributes to the Government of Canada's Science and Technology Strategy. It fosters the generation of knowledge as well as technological spin–offs that contribute to a higher quality of life for Canadians. It generates excitement within the population in general and contributes to nation–building. This Program appeals to the science and technology communities. It is targeted mostly towards Canadian academia and international space exploration partnerships. Canadian industry also benefits from the work generated within this Program.

This Program is delivered with the participation of foreign space agencies and GoC organizations. This collaborative effort is formalized under international partnership agreements, contracts, grants or contributions.

2012–13 Financial Resources ($ in millions)

Total Budgetary Expenditures (Main Estimates)	Planned Spending	Total Authorities (available for use)	Actual Spending (authorities used)	Difference
100.0	106.3	108.1	87.5	18.8

Due to rounding, decimal points may not add up to total shown.

Any significant variance reported in relation to the Planned Spending set out in the 2012–13 RPP is explained in Section 4.2.1 – Spending by Program.

2012–13 Human Resources (FTEs)

Planned	Actual	Difference
196.1	176.8	19.2

Due to rounding, decimal points may not add up to total shown.

Space Exploration 2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
Expansion of scientific knowledge acquired through space exploration endeavours.	1. Number of peer–reviewed scientific publications, reports and conference proceedings using space exploration information and produced by researchers (sciences and technologies) in Canada.	Approximately 100 publications per year for a target of 500 peer–reviewed scientific publications, reports and conference proceedings over a 5–year timeframe.	246
EXPECTED RESULT #2			
Multiple use for and applications of knowledge and know--how acquired through space exploration endeavours.	1. Number of terrestrial applications of space re–utilization of knowledge and know–how acquired through space exploration endeavours.	5	5

PERFORMANCE SUMMARY AND ANALYSIS OF PROGRAM

Expected Result # 1

All space exploration missions are conducted under international partnerships. The CSA's success in space depends on its ability to contribute to world-class science, technology and know–how. In order for Canada's space program to generate knowledge and economic returns and be sustainable, a combination of elements must work closely together: a competitive industry mastering advanced technologies, highly qualified scientists producing leading–edge research, terrestrial applications from space activities that positively impact the lives of Canadians, and smart and timely positioning of Canadian science and technology with our international space partners.

The Canadian space program has achieved notable international successes through Canadian scientists' contributions to physical sciences, space life sciences, space astronomy and planetary sciences. A total of 246 scientific publications, compared with 139 last year, were produced by 76 organisations using information made available by CSA's funded space exploration instruments. Because of our access to the ISS and space-related opportunities, we increased our understanding of the role of gravity in physical phenomena, changes impacting humans in space, the solar system and the universe.

Expected Result # 2

In 2012–13, space exploration missions and programs generated 5 terrestrial applications and space re-utilization of knowledge and know-how, which were re-utilized in commercial markets or space exploration endeavours. For example, Neptec has formed a spin-off company (Neptec Technologies) to address the terrestrial market: the Opal-360 laser sensor derived from the prototypes developed under CSA funding addresses the market of autonomous off-road vehicles in harsh environments. Other examples include the usage by NASA of drilling and avionics technologies in analogue deployments to demonstrate future mission concepts. Lastly, the robotic technology of the Canadarm developed by MDA has been translated into neuroArm, the first robot able to perform surgery inside a magnetic resonance machine with enhanced dexterity and without tremors that would be catastrophic for brain surgery. IMRIS Inc. of Winnipeg, Manitoba is seeking regulatory approval for the neuroArm, which has already demonstrated its value in removing previously inoperable brain tumours in clinical trials.

LESSONS LEARNED

The end of a mission signals the end of data collection. However, data analysis and the publication of findings can continue for several years post-mission. An internal policy is currently being drafted to guide the management of mission life, including post flight science activities such as data analysis and reporting.

The CSA develops and updates plans and roadmaps for space exploration in order to have a balanced, conservative yet diverse portfolio of R&D activities and missions with the highest rate of return for innovation and benefits. Without launch capacity, the CSA continues to rely on partners and the inherent risks and costs of space missions often being modified, delayed and even cancelled. Having a varied portfolio, the CSA mitigates this risk with alternative science, systems and technologies for other available opportunities.

Sub–Program: 1.2.1. International Space Station (ISS)

Description: This SP uses the International Space Station (ISS) – a unique Earth orbiting laboratory – to learn, to live and work in space while conducting scientific, medical and engineering studies. It includes the assembly and maintenance of the ISS through the use of the Canadian Mobile Servicing System (MSS) and the design, development and operations of payloads and technological demonstrations onboard the ISS. This SP fosters specific understanding and technological advances to generate and to prepare for the challenges of space exploration and for terrestrial benefits. This SP provides Canadian industry and academia privileged access to the ISS.

This SP is performed in collaboration with GoC organizations and foreign space agencies. This collaborative effort is captured under contracts, contributions, grants and/or international partnership agreements.

2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
Development of operational and technological know--how related to long-duration space missions (with potential Earth application) acquired through participation in International Space Station (ISS) operations and laboratory missions.	Number and percentage (and description) of Canadian missions/solutions/instruments flown on ISS that met their mission requirements.	In accordance with ISSP requirements.	**Target met:** 100% of planned ISS operations requiring the MSS were supported during the fiscal year.
EXPECTED RESULT #2			
Canada, a well-positioned partner, influences ISS Program direction (in which each partner has an equal vote).	Number of CSA participation in ISS programs boards and panels.	In accordance with ISSP management.	**Target met:** 100% of all scheduled ISS management meetings were supported during the fiscal year.

Performance Summary and Analysis of Sub–Program

Expected Result #1

The CSA has fulfilled its International Space Station (ISS) obligations by operating the Mobile Servicing System (MSS) to meet all operations planned in the ISS schedule. In the last year, the MSS was powered up and operational for 840 hours and supported 17 major operations (e.g., visiting vehicle capture, payload relocation and technology, etc.) and many minor operations. The CSA continues to develop and certify new flight products, for example:

- Support was provided for the on–orbit Robotic Refueling Mission (RRM) in which the Cooling Valve Task (CVT) and the Fuel Transfer Demo were successfully completed.
- The release of a new software version, MSS 7.2, which included major enhancements to increase MSS failure tolerance, improve MSS ground control operations capability, and solve existing software issues that were problematic for operators.

The CSA completed the MSS assessment and determined that the system's life can be extended until 2020. Analysis to determine whether or not additional spares parts are required has been initiated and will be completed in 2013.

The CSA used all of its allocated ISS utilization resources. Five Canadian ISS utilization experiments were conducted and are summarized below:

BCAT-C1 = Binary Colloid Alloy Test. This experiment gathers unique data on the physical characteristics of colloids which are important ingredients in many commercial products such as paints and pharmaceuticals.

VASCULAR = This ongoing experiment, led by scientists at the University of Waterloo, examines the impact of long–duration space flight on inflammation of the blood vessels of astronauts.

BP Reg = The goal of the experiment is to assess the reliability of a simple test for cardiovascular deconditioning.

Radi-N2 = A collection of neutron radiation exposure data gathered with international partners on the ISS using the Canadian-made radiation dosimeter (Bubble Detector).

Microflow-1 = Microflow technology enables scientists and physicians to quantify molecules and cells in blood or other body fluids. This is a first step in providing future capacity to provide real-time medical care for crewmembers.

Tomatosphere III: Tomato seeds were housed on the ISS for several years and have returned to Earth. They will be distributed to students to grow and compare with tomato seeds that have not been in space.

Overall, Canada is both meeting its ISS obligations and maximizing its ISS program objectives. Since 2010, Canada has completed 15 activities using its allocation in addition to another 5 being completed in collaboration with other partners. Users have included 15 academic institutions, 5 industry suppliers, and one GoC organization. Over time, ISS access has made advancements in several fields of research including changes that afflict an aging population, forestry and industrial chemistry, risks encountered in space that are related to variable gravity, radiation and the extreme isolated, confined environment of space. In addition, the ISS has been used as an outreach and education platform to showcase Canadian science and technology.

Source: Internal reporting documents.

Expected Result #2

CSA representation within the formal ISS Program structures is defined as essential meetings that managers and personnel attend to support CSA objectives and responsibilities for the Mobile Servicing System (MSS) to the overall benefit of the ISS partnership and Canada. Key multilateral boards and panels within the ISSP structures are the following:

– Heads of Agency (HOA);
– Multilateral Control Board (MCB);
– Space Station Control Board (SSCB);
– Space Operations Readiness Review (SORR);
– Flight Readiness Review (FRR);
– Multilateral Avionics and Software Control Board (MASCB);
– Multilateral Program Integration Control Board (MPICB);
– Multilateral Program Integration and Operations Control Board (MIOCB);
– Multilateral Vehicle Control Board (MVCB);
– International Training Control Board (ITCB);
– Mobile Servicing System Integration Panel (MIP); and
– Canadian Joint Operations Panel (CJOP).

Source: Internal reporting documents.

SSPs Overall Achievements vs. Planned Targets
In 2012–13, the targets of all 4 indicators were met.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
44.3	43.3	1.0

Due to rounding, decimal points may not add to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
102.6	94.6	8.0

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into two Sub-Sub-Programs:

*1. **Sub-Sub-Program 1.2.1.1. International Space Station Assembly and Maintenance Operations***

Description: This SSP includes the provision and operation of the Canadian Mobile Servicing System (MSS), composed of three Canadian robots – Canadarm2, Dextre and the Mobile Base System. MSS operations and maintenance services are conducted by Canadian or foreign astronauts on board the International Space Station (ISS) and by ground controllers and engineers located in established facilities at the CSA and the National Aeronautics and Space Administration (NASA) – Johnson Space Center. This SSP also includes the provision of specialized MSS training, systems engineering and software services, flight procedures development as well as the facility infrastructure necessary to operate the MSS through its life cycle. This SSP fosters Canada's ongoing commitment to fulfill to the international partnership to assemble and maintain the ISS, a legally binding obligation under the Canadian *Civil International Space Station Agreement Implementation Act.*

EXPECTED RESULT #1

The Canadian contribution MSS meets the planned operational requirements identified in the ISS Increment Definition Requirements Document (IDRD) in accordance with the Intergovernmental Agreement (IGA) and the NASA/CSA Memorandum of Understanding (MOU).

Indicator	Performance
1. The Mobile Servicing System (MSS) fulfills its operational requirements. (Target: Scheduled MSS operations conducted in accordance with ISSP requirements).	**Target met:** The MSS supported all ISS operations and was even able to provide unplanned support to certain missions.
Additional Information As documented in the 1.2.1 Performance Summary Analysis of Sub–Program. Source: Internal reporting documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
38.6	39.0	(0.4)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
85.7	77.3	8.4

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.2.1.2. International Space Station Utilization*

Description: This SSP encompasses the implementation of scientific, operational, medical and technological studies in specific areas, such as life sciences, radiation, material or fluid sciences, to be conducted onboard the ISS by GoC organizations, academia or the private sector. This ISS offers them the advantages of an orbiting platform with human presence and prolonged microgravity exposure. This SSP fosters testing novel technologies and conducting scientific studies in the unique environment of the ISS, leading to a better understanding of long–duration space missions and to potential terrestrial benefits.

This SSP is performed in collaboration with GoC organizations and foreign space agencies. This collaborative effort is captured under contracts, contributions, grants and/or international partnership agreements.

EXPECTED RESULT #1

Optimal utilization of the International Space Station (ISS).

Indicator	Performance
1. Ratio of programmatic objectives (science, technology, medicine, communications and education) achieved through ISS utilization. (Target: 5/5)	**Target met:** 5/5
Additional Information As documented in the 1.2.1 Performance Summary Analysis of Sub–Program. Source: Internal reporting documents.	
Indicator	**Performance**
2. Number of Canadian stakeholders involved in activities on the ISS. (Target: 2)	**Target exceeded:** 4

Additional Information

A summary of the stakeholders is shown below:

- VASCULAR and BP–Reg: University of Waterloo;
- BCAT-C1: Simon Fraser University;
- Microflow–1 : Institut National d'Optique, Calm Technologies; and
- Radi–N2: .Royal Military College, Bubble Technologies.

Source: Internal reporting documents.

Indicator	Performance
3. Proportion of ISS resources used. (Target: 100%)	**Target exceeded:** 101.5%

Additional Information

Crew time is the most constrained resource on ISS:

- From May, 2012 to September, 2012: 102% of allocated crew–time was used.
- From October, 2012 to March, 2013: 101% of allocated crew–time was used.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
5.7	4.2	1.5

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
16.9	17.2	(0.4)

Due to rounding, decimal points may not add up to total shown.

Sub–Program: 1.2.2. Exploration Missions and Technology

Description: This SP encompasses the development and use of astronomy and planetary missions as well as the development of advanced exploration technologies. This SP fosters international space exploration endeavours as it contributes to valued Canadian signature technologies and generates a better understanding of the universe, the solar system and our home planet. It could also lead to technology transfers for terrestrial benefits. This SP provides Canadian industry and academia with unique opportunities through their participation in international space exploration initiatives.

This SP is performed in collaboration with foreign space agencies, GoC organizations and through CSA participation in international groups, such as the International Space Exploration Coordination Group. This collaborative effort takes shape under contracts, grants, contributions and/or international partnership agreements.

2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
Technological know–how acquired through Space Exploration endeavours (astronomy and planetary).	1. Proportion of CSA missions/ solutions /instruments that met their mission performance requirements in acceptance reviews and/or at commissioning.	6	**Target partially met:** 3
EXPECTED RESULT #2 Canada maintains a strategic position that supports its capacity to influence space exploration missions and decision making in key international space exploration forums.	1. Number of CSA sponsored highly qualified personnel (HQP) appointed to International Space Exploration decision-making bodies.	10	**Not measured in 2012–13**
EXPECTED RESULT #3 CSA participation in space exploration missions provides access to scientific data about the solar system and the universe.	1. Number of CSA sponsored space astronomy and planetary missions' providing data for the Canadian scientific community.	8	**Target partially met:** 5 (4 Space Astronomy and 1 Planetary Mission).

Performance Summary and Analysis of Sub–Program
Expected Result #1 Commissioning of the APXS instrument on NASA's Curiosity rover; Acceptance and delivery of FGS/NIRISS payload for the James Webb Space Telescope Mission; Usage of Q6 card in joint CSA–NASA RESOLVE analogue mission. Source: Internal reporting documents.
Expected Result #2 Information for this indicator will be provided next year once the upcoming internal audit and evaluation of the Advanced Exploration Technology Development Program reports become available (Canada's Economic Action Plan).
Expected Result #3 With five missions in operation (Herschel, Planck, NEOSSat, MOST and APXS) and support provided for an archiving system used to received astronomy data from missions such as HUBBLE, the CSA continued to fulfill the needs of a variety of users in the astronomy and planetary academic community. Source: Internal reporting documents.
SSPs Overall Achievements vs. Planned Targets In 2012–13, the targets for all 3 indicators were met.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
57.8	39.3	18.5

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
75.9	65.7	10.3

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into three Sub-Sub-Programs:

1. Sub-Sub-Program 1.2.2.1. Space Astronomy Missions

Description: This SSP encompasses the definition, design, technology development, implementation and use of complete Canadian space telescope systems and the provision of Canadian instruments, sensors and sub–systems to international space telescope or probe missions. This SSP fosters scientific data to generate about the universe through the observation of the solar system and deep space.

This SSP is performed in collaboration with foreign space agencies, GoC organizations and through consultation with the Canadian Astronomical Society. This collaborative effort takes shape under contracts, grants, contributions and/or international partnership agreements.

EXPECTED RESULT #1

Canadian know–how and expertise allow Canada to lead or participate in international space astronomy missions.

Indicator	Performance
1. Number of technological and scientific solutions being developed by the CSA in the context of astronomy missions. (Target: 2)	**Target exceeded:** 3 technical/scientific solutions developed within the context of space astronomy missions.

Additional Information

- JWST = James Webb Space Telescope. The JWST is a successor to the highly successful Hubble Space Telescope. Canada is responsible for the design and construction of the JWST Fine Guidance Sensor (FGS) and a science instrument named NIRISS (Near Infrared Imager and Slitless Spectrograph).
- CAMS = An instrument for the JAXA ASTRO–H mission. The CSA's participation will provide Canadian scientists with access to this large X–ray telescope.
- NEOSSat = Near Earth Object Surveillance Satellite. This is a microsatellite jointly sponsored by the CSA and Defence Research and Development Canada (DRDC) to acquire useful metric (position/time) data on Near Earth–orbiting objects (asteroids) and man–made objects (spacecraft and space debris).

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
17.5	15.3	2.2

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
23.7	16.7	6.9

Due to rounding, decimal points may not add up to total shown.

2. Sub-Sub-Program 1.2.2.2. Planetary Missions

Description: This SSP encompasses the definition, design, technology development, implementation and use of Canadian exploration signature technologies and scientific instruments made available to international exploration missions. The SSP fosters remote bodies (planets, asteroids, etc.) to reach and to conduct detailed observations and science.

This SSP is performed in collaboration with the International Space Exploration Coordination Group, GoC organizations and foreign space agencies. This collaborative effort takes shape under contracts, grants, contributions and/or international partnership agreements.

EXPECTED RESULT #1	
Canadian know–how and expertise allow Canada to participate in planetary exploration missions.	
Indicator	**Performance**
1. Number of technological and scientific solutions being developed by the CSA in the context of planetary missions. (Target: 1)	**Target met:** 1 technical/scientific solution developed within the context of planetary missions.
Additional Information The OSIRIS–REx Laser Altimeter (OLA) instrument, an advanced scanning lidar, will provide global topographic mapping of an asteroid surface, assist the mission as a navigation aid and provide scale for images and spectra in support of the OSIRIS–REx mission. Source: Internal reporting documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
23.7	8.7	15.1

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
12.5	9.9	2.6

Due to rounding, decimal points may not add up to total shown.

3. Sub-Sub-Program 1.2.2.3. Advanced Exploration Technology Development

Description: This SSP includes the development of advanced Canadian signature technologies to be used in potential astronomy and planetary missions that could be destined for the Moon, Mars, asteroids or other celestial bodies. This SSP fosters the nature of Canada's contribution to potential international exploration and astronomy missions to shape or determine and could lead to spin–offs. In addition, the SSP includes terrestrial deployments in analogue sites that offer geological similarities with Martian or Lunar surfaces, where this technology and its operational aspects are being tested and where exploration–related science is conducted for proof of concepts.

This SSP is performed in collaboration with foreign space agencies and GoC organizations and through the Canadian Space Agency participation in international

groups, such as the International Space Exploration Coordination Group. This collaborative effort takes shape under contracts and/or international partnership agreements.

EXPECTED RESULT #1	
Maturing science, technology and operational solutions for planning and strategic positioning purposes.	
Indicator	**Performance**
1. Number of science, technology and operational solutions that are under development in accordance with the directions and conclusions of the Canadian Space Exploration plan. (Target: 11)	**Target exceeded:** 34 solutions were under development during 2012–13.
Additional Information 10 data analysis and concept studies for future missions. 20 prototype solutions. 4 analogue deployments. Source: Internal reporting documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
16.6	15.3	1.3

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
39.7	39.0	0.7

Due to rounding, decimal points may not add up to total shown.

Sub–Program: 1.2.3. Human Space Missions and Support

Description: This SP encompasses all activities required to recruit, develop, train and maintain a healthy and highly–qualified Canadian astronaut corps capable of participating in space exploration missions. It also includes all activities directed at mitigating health risks associated with those missions, such as the development of advanced technologies to be used in support of human space missions. This SP fosters the generation of specialized knowledge in fields that sustain human space flights, such as life sciences and space medicine. Furthermore, by exploring technological solutions to the various challenges of human space flight, this SP could contribute to alternate healthcare delivery mechanisms for terrestrial applications.

This SP is performed with GoC organizations and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions or international partnership agreements.

2012–13 Program Performance Measurement

EXPECTED RESULT #1	PERFORMANCE INDICATORS	TARGETS	ACTUAL RESULTS
Human space flight generates "unique" health and life sciences knowledge, and technological know–how to sustain life and mitigate health risk during long–duration space flight.	1. Number of activities that lead to health risk mitigation strategies, technologies and/or countermeasures.	4	**Target exceeded:** 7 activities.

Performance Summary and Analysis of Sub–Program

Expected Result #1

1. C2 Mission
2. Vascular
3. BP Reg
4. Radi–N2
5. Bedrest studies
6. Hypersole
7. Microflow

This year, the Canadian Space Program celebrated an important new milestone: Chris Hadfield became the first Canadian to command the ISS. During his five–month mission, Hadfield and his crew set new records for the amount and quality of science experiments.

The two newest Canadian astronauts, Dr. David Saint–Jacques and Major Jeremy Hansen, continued their training. They were assigned as Crew Support Astronauts during Chris Hadfield's mission, during which they were exposed to all critical aspects of the training and operations, and gained invaluable experience.

The CSA also supported several experiments in the life science field such as the following:
Microflow: A miniature flow cytometer was shown to successfully function in space. Microflow enables scientists and physicians to quantify molecules and cells in blood and other body fluids. This represents a first step in providing future real–time medical care for crewmembers.
The **Vascular** experiment examines the impact of long–duration space flight on inflammation of the blood vessels of astronauts. Inflammation in blood vessels can lead to atherosclerosis and a higher risk of cardiovascular disease later in life.
The **BP Reg** experiment was conducted to assess the reliability of a simple test for cardiovascular deconditioning. In addition to providing additional insight into astronaut health, it is expected that the findings will also apply to the general population. Dizziness and fainting in the elderly is a common cause of injury and visits to the doctor and emergency rooms. The CSA is now partnering with the Canadian Health Research Institute of Ageing to bring together space and ageing research support agencies in order to explore ways to leverage resources to address problems afflicting both astronauts and ageing people.
Radi–N2 is an ongoing activity on the ISS for the purpose of characterizing the neutron radiation field inside the ISS.

Source: Internal reporting documents.

SSPs Overall Achievements vs. Planned Targets

In 2012–13, the targets for 4 of the 5 indicators were met. 1 target was partially met in SSP 1.2.3.2 Operations Space Medicine.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
4.2	5.0	(0.8)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
17.6	16.6	1.0

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into three Sub-Sub-Programs:

1. Sub-Sub-Program 1.2.3.1. Astronaut Training and Missions

Description: This SSP encompasses activities associated with all phases of an astronaut career from recruitment to retirement, including space missions. This SSP includes the management of National Astronaut Recruitment Campaigns; the implementation of individualized astronaut career management plan; the implementation of basic, advanced and mission–specific training; collateral duties assignment; space mission negotiations and assignment; as well as all the logistical, administrative and operational support activities in the pre–flight, in–flight and post–flight periods. This SSP fosters the life and work in a space environment and in order to further our understanding of human behaviour and health in space, and to conduct experiments and collect space–based scientific data useful to the science community.

This SSP is performed with GoC organizations and foreign space agencies. This collaborative effort is formalized under contracts or international partnership agreements.

EXPECTED RESULT #1

The Canadian astronaut corps is ready to assume any responsibilities on an expedition to the International Space Station (ISS).

Indicator	Performance
1. Number of astronaut activities undertaken in preparation for possible ISS mission assignments. (Target: 3)	**Target exceeded:** 6 activities.

Additional Information

Astronauts David Saint–Jacques and Jeremy Hansen have both undertaken the following activities in preparation for an eventual ISS mission:

1- ISS Systems Training.
2- Russian Language Training.
3- Flight Training.
4- Field Science and Leadership Training.
5- Strategic Collateral Duties within the NASA JSC Astronaut Office.
6- Public Relation activities.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
3.2	3.2	0.0

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
14.6	10.3	4.3

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.2.3.2. Operational Space Medicine*

Description: This SSP delivers operational and clinical healthcare activities during all phases of basic, advanced and mission–specific training as well as during the pre–flight, in–flight and post–flight periods. It also promotes and ensures the physical, mental, social well–being and safety of Canadian astronauts. This SSP fosters the overall health of Canadian astronauts to ascertain and to monitor long–term health status.

This SSP is performed with GoC organizations and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions or international partnership agreements.

EXPECTED RESULT #1

Astronauts' health is optimized to meet mission requirements.

Indicator	Performance
1. Number of active astronauts medically certified for ISS assignment and duties. (Target: 3/3)	**Target met:** 3/3

Additional Information

Active astronauts are astronauts actively training for the purpose of flight assignment. Training includes basic and mission-specific training as well as all collateral duties to which an astronaut is assigned.

ISS Medical Certification is an annual process requiring medical investigations and exams as per the medical requirements defined in the ISS Medical Evaluation Document A (MED A – Medical Standards for ISS Crewmembers). Once completed, the results are submitted to the ISS Multilateral Space Medicine Board (MSMB), which will issue a medical disposition (medically certified for ISS duties, medically certified for ISS Training, medically disqualified for ISS duties).

Source: Internal reporting documents.

EXPECTED RESULT #2

Astronauts' long–term health is monitored following their active careers.

Indicator	Performance
1. Ratio of eligible astronauts invited and sponsored to participate in their long–term health monitoring. (Target: 5/7)	**Target partially met:** 3/7

Additional Information

The target is partially met because it is beyond of our control, given that retired astronauts participate in this activity on voluntary basis. There is ongoing encouragement of astronauts to continue the monitoring of their long–term health by participating in the Long–Tem Study of Astronaut Health (LSAH).

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
0.6	0.8	(0.2)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
1.8	2.8	(1.1)

Due to rounding, decimal points may not add up to total shown.

3. *Sub-Sub-Program 1.2.3.3. Health and Life Sciences*

Description: This SSP encompasses space medicine and life sciences activities that explore health care delivery and life sustainability solutions on future long-duration exploration missions. These benefits are targeted at the space exploration community, mainly academia and partnering agencies. This SSP develops collaborative projects with academia and industry. It uses analog sites that offer relevant similarities with the harsh environment of space, and where exploration-related medical and life science studies are conducted. This SSP fosters health risks associated with human space flights to identify, understand, mitigate or eliminate, and to understand and address the needs of humans during those missions. The solutions could also be offered as alternative healthcare delivery mechanisms for terrestrial benefits through the transfer of space technology.

This SSP is performed with GoC organizations and foreign space agencies. This collaborative effort is formalized under contracts, grants, contributions or international partnership agreements.

EXPECTED RESULT #1

Performance of space life sciences studies with potential benefits for Canadians and to enable human exploration of space.

Indicator	Performance
1. Number of studies aiming at the development of countermeasures and enhanced human performance and life support. (Target: 3)	**Target exceeded:** 4

Additional Information

Hypersole, VASCULAR, and BP REg all had activities on the ISS or involved data collection before the ISS experiment.
The University of Ottawa also began an analysis of bed-rest samples in order to identify new countermeasure targets.

Source: Internal reporting documents.

Indicator	Performance
2. Number of partnerships addressing potential terrestrial healthcare solutions. (Target: 1)	**Target met:** 1

Additional Information

The Canadian Institutes of Health Research (CIHR)–CSA partnership for the funding of two projects resulted from the nanohealth RFP.

In addition, the CSA co-hosted a national Space Health and Ageing Research—(SHARE) workshop looking at parallels between changes impacting astronauts in space and those associated with ageing. Based on the results of the workshop, 4 reviews summarizing the research in ageing and space parallels in the areas of (1) psycho–social issues, (2) neuroscience, (3) cardiovascular system, and (4) musculo-skeletal system were produced.

This workshop has led to plans for an international workshop in the future.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
0.4	1.0	(0.6)

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
1.2	3.5	(2.3)

Due to rounding, decimal points may not add up to total shown.

Planning and Reporting Continuity

RPP 2012-2013 and DPR 2011-2012:
http://www.asc-csa.gc.ca/eng/publications/rp.asp

To learn more about space science and exploration, go to:
http://www.asc-csa.gc.ca/eng/sciences/default.asp and,
http://www.asc-csa.gc.ca/eng/exploration/default.asp

2.2.3) PROGRAM – 1.3. FUTURE CANADIAN SPACE CAPACITY

Description: This Program attracts, sustains and enhances the nation's critical mass of Canadian space specialists, fosters Canadian space innovation and know–how, and preserves the nation's space–related facilities capability. In doing so, it encourages private–public collaboration that requires a concerted approach to future space missions. This Program secures the nation's strategic and on–going presence in space in the future and to preserve Canada's capability to deliver internationally renowned space assets for future generations. It is targeted at Canadian academia, industry and youth, as well as users of Canadian space solutions (GoC organizations) and international partners.

This Program is conducted with the participation of funding agencies, GoC organizations along with government facilities and infrastructure, foreign space agencies, not–for–profit organizations and provincial governments. This collaborative effort is formalized under contracts, grants, contributions or national and international partnership agreements.

2012–13 Financial Resources ($ in millions)

Total Budgetary Expenditures (Main Estimates)	Planned Spending	Total Authorities (available for use)	Actual Spending (authorities used)	Difference
63.3	63.3	63.4	52.5	10.8

Due to rounding, decimal points may not add up to total shown.

Any significant variance reported in relation to the Planned Spending set out in the 2012–13 RPP is explained in Section 4.2.1 – Spending by Program.

2012–13 Human Resources (FTEs)

Planned	Actual	Difference
116.5	108.4	8.2

Due to rounding, decimal points may not add up to total shown.

Future Canadian Space Capacity 2012–13 Program Performance Measurement			
Expected Result	**Performance Indicators**	**Targets**	**Actual Results**
Canada has a space community (academia, industry and government) able to contribute to the sustained and strategic Canadian use of space.	1. Vitality index of the Canadian space Community-measured in terms of: number of HQP/total of FTE; value of public and private R&D investments; value of public- and private-sector development facilities; number of technology domains covered; number of university space-related programs.	First measurement to be conducted in September 2013.	Though no formal measure is available this year, progress toward the expected result is summarized below.
	2. Degree of match between work force supplied and space community (industry and government) workforce requirements.	Methodology to be introduced in 2014 DPR.	No formal measure is available this year.

Performance Summary and Analysis of Program

Vitality of the Canadian space community

The latest information made available in the 2011 annual *State of the Canadian Space Sector* revealed that the Canadian space sector generated total revenues of $3.483 billion, amounting to a 1.3% increase over the 2010 results and continuing the upward trend of the past four years. Domestic revenues grew by 4.8% or $83M in 2011, reaching $1.818B. Export revenues decreased by 2.2%, or $38M, to $1.665B, which was lower than in 2010, but not below the 2009 levels.

R&D expenditures in space totalled $69 million in 2011, with 44 organizations undertaking space R&D projects. These numbers represent a slight decrease compared with the 2010 R&D expenditures in space, which totalled $72 million and involved 50 organizations undertaking space R&D projects.

For the first time since 2007, the Canadian space sector workforce across the country decreased to a total of 7,494 employees. Of the 762 positions lost, 507 were classified as Highly Qualified Personnel (HQP).

Although the first measurements of the performance indicators at the program level will take place in 2013-2014, a survey was conducted in 2012–13 that targeted the principal investigators in 215 organizations and the 164 research partnerships receiving funding, some of it from the CSA. According to this survey, their work resulted in a total of 981 publications and 1,350 presentations.

Available workforce and space community workforce requirements

In the early stage of implementation of the Flights for the Advancement of Science and Technology (FAST) initiative, a preliminary survey was conducted in the Canadian space industry to understand how well the available workforce available was meeting the Canadian industry requirements. Several survey participants said they had difficulty recruiting the qualified personnel they needed. In their opinion, the prospective space sector workers developed in Canadian universities had insufficient hands-on experience and had to increase their knowledge in the fields of mechanical engineering, industrial design, software development and project management. Based on these considerations, the CSA will focus its scientific and academic development activities (including the FAST initiative) in such a way that training opportunities are matched with the needs expressed by the Canadian industry.

LESSONS LEARNED

An evaluation of the Space Technology Development Program (STDP), which is part of Enabling Technology Development sub-sub-program, was released in July 2011. The report recommended that the STDP prioritize and focus on the objectives of reducing the risks associated with space missions, improving management procedures and better communicating results to CSA clients. The CSA developed a procedure for prioritizing the technical needs identified for future missions of interest to Canada and issued technology development contracts in areas that were selected. In addition to reducing the level of technical uncertainty in future missions, the new procedure is expected to boost industry competitiveness.

Sub–Program: 1.3.1. Space Expertise and Proficiency

Description: This SP includes the development and enhancement of Canada's space capacity through people. To do so, it supports research in private or public organizations and includes learning activities targeted at Canadian youth. This is accomplished by encouraging scientists and engineers to pursue relevant space science and technology development activities with attractive initiatives and top facilities, and by promoting scientific and technical studies with Canadian students. This SP fosters a pool of space expertise and proficiency to create and sustain and will form the next generation of space professionals and workers, continuously able to provide solutions for future Canadian space endeavours. The activities are carried out mostly by Canadian academia, under the leadership of, in collaboration with, and with the support of the CSA and/or industry.

This SP is delivered with the participation of funding agencies, GoC organizations, foreign space agencies, not–for–profit organizations and provincial governments. This collaborative effort is formalized under grants, contributions or national and international partnership agreements or contracts.

2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
A pool of space experts and professionals is sustained and enhanced.	1. Number of organizations (universities, research centres, etc.) that include space theme in their program planning.	> Than last year's (8).	**Target exceeded:** 19
	2. Number of registrations in spac-related learning activities (post-secondary levels).	Last year's + 10 (169 + 10).	**Target not met:** 24
	3. Number of scientists and engineers pursuing space research and activities.	750	**Target exceeded:** 930

Performance Summary and Analysis of Sub–Program

Expected Result #1

Indicator 1

Last year's number of organizations was 8. In 2012–13, the following 19 organizations were identified:

University of Toronto: 8 funded programs and 1unfunded programs;
University of Calgary: 6 funded programs;
University of Alberta: 3 funded programs;
University of Western Ontario:2 funded programs and 1 unfunded;
University of British–Columbia: 3 funded programs;
University of New–Brunswick: 2 funded programs;
McGill University: 2 funded programs;
Victoria University: 1 funded program and 1 unfunded;
University of Guelph: 2 funded programs;
York University: 2 funded programs; and
9 other organizations with 1 funded program.

Source: Internal reporting documents.

Indicator 2

Overall, 24 students obtained learning opportunities supported by the CSA. The allocated grants supporting the development of students who benefited from learning activities or conference participation related to space science and technology were limited to students at universities that were to be the centre of the learning activities. Performance related to Awareness and Learning includes support for student participation at the International Aeronautical Congress and other activities such as the Space Capstone project at the University of Toronto and the Science Honours project at the University of Victoria.

Source: Internal reporting documents.

Indicator 3

The number of scientists and engineers includes undergraduate, graduate and post-doctoral fellows, research assistants, research associates, faculty and non-faculty staff in post-secondary institutions and not-for profit organizations as well as students and visiting fellows at the CSA. Space research and activities refer to certificates, degrees, courses and research projects that have received transfer payments from the CSA or have otherwise received support or cooperation from the CSA to create, enhance or deliver them.

Source: Space Learning Program Survey and internal documents.

SSPs Overall Achievements vs. Planned Targets

In 2012–13, the targets of 2 of the 6 indicators were met and 4 were cancelled;. 3 targets cancelled in SSP 1.3.1.1 Space Learning and 1 target cancelled in SSP 1.3.1.2 Support to Scientists and Engineers.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
18.2	13.9	4.2

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
66.2	53.7	12.5

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into two Sub-Sub-Programs:

1. Sub-Sub-Program 1.3.1.1. Space Learning

Description: This SSP uses space to increase interest in science and technology among Canadian students and educators and promotes the development of hands–on expertise. This SSP reaches primary, secondary, college and university students through the development of curriculum–based educational materials; through on–site and off–site presentations and training, in class or via distance learning; and through educator professional development, training conferences and workshops. This SSP fosters tomorrow's space experts and professionals to attract and develop.

This SSP is delivered in collaboration with Provincial and Territorial Ministries or Departments of Education, Boards of Education, and not–for–profit organizations, and is formalized through grants, contributions, and collaborative agreements and contracts.

EXPECTED RESULT #1

Educators further their professional development through the space theme.

Indicator	Performance
1. Number of educators reached through professional development initiatives.	**Cancelled**

Additional Information

Following a program review, it was decided to no longer provide funding for initiatives in the Awareness and Learning Component of the Class G&C Program therefore, all expected accomplishments related to Space Learning have been suspended.

Source: Internal documents.

EXPECTED RESULT #2

Students further their learning related to science and technology through space-related themes.

Indicator	Performance
1. Number of students reached through space-related learning opportunities.	**Cancelled**

Additional Information

Following a program review, it was decided to no longer provide funding for initiatives in the Awareness and Learning Component of the Class G&C Program therefore, all expected accomplishments related to Space Learning have been suspended.

Source: Internal documents.

EXPECTED RESULT #3	
Space training and academic programs, initiatives, activities or other opportunities offered are used by targeted institutions.	
Indicator	**Performance**
1. Number of institutions that use space-related themes in their activities.	**Cancelled**
Additional Information Following a program review, it was decided to no longer provide funding for initiatives in the Awareness and Learning Component of the Class G&C Program therefore, all expected accomplishments related to Space Learning have been suspended. Source: Internal documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
1.8	0.4	1.4

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
3.4	0.9	2.5

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.3.1.2. Support to Scientists and Engineers*

Description: This SSP includes supporting graduate university students and working professionals through shorter lead–time and small–scale missions that allow frequent flight opportunities and through the upgrade of world–class space research and training facilities that secure Canada's ongoing strategic presence in space. These actions encourage private and public research establishments to devote portions of their activities to space research. This SSP fosters the space sector to attract scientists and engineers and encourage them to develop their space know–how.

This SSP is delivered with the participation of funding agencies, GoC organizations, foreign space agencies, not–for–profit organizations and provincial governments. This collaborative effort is formalized under grants, contributions, or national and international partnership agreements or contracts.

EXPECTED RESULT #1	
Scientists and engineers advance their space proficiency and know–how through the opportunities offered in priority space science and technology areas.	
Indicator	**Performance**
1. Number of scientists and engineers involved in opportunities provided under the program. (Target: 750)	**Target exceeded:** 930
Additional Information The number of scientists and engineers involved in such opportunities is likely to fluctuate from year to year. This year, a 25% fluctuation occurred. Source: Internal reporting documents.	
Indicator	**Performance**
2. Number of opportunities offered per year to scientists and engineers. (Target: 9)	**Target exceeded:** 11
Additional Information There were 11 students and visiting fellows who were provided with research/training opportunities at CSA facilities. Source: Internal reporting documents.	
Indicator	**Performance**
3. Number of collaborative research agreements (in place or in development).	**Cancelled:**
Additional Information Following a program review, it was decided to no longer provide funding for initiatives in the Awareness and Learning Component of the Class G&C Program therefore, all expected accomplishments related to Space Learning have been suspended. Source: Internal reporting documents.	

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
16.4	13.5	2.9

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
62.8	52.8	10.0

Due to rounding, decimal points may not add up to total shown.

Sub–Program: 1.3.2. Space Innovation and Market Access

Description: This SP includes the development and enhancement of Canada's space capacity through innovation and market positioning. Through leading–edge technology and facilities, and international arrangements, the SP improves Canadian industrial competitiveness so that space users are continuously well served through constantly improving optimal and cost–effective space solutions. This SP fosters entrepreneurship that enhances Canadian industry's international positioning on commercial and government markets.

This SP is performed with industry and is formalized under contracts or contributions. Foreign space agencies are partners in this endeavour, so that Canadian industry can access foreign markets through innovation or international arrangements.

2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATORS**	**TARGETS**	**ACTUAL RESULTS**
Through innovation and international arrangements, Canadian industry is well positioned in international commercial and government markets.	1. Number of Canadian companies (size) exporting space–related goods and services (value).	50	**Target exceeded:** 51 companies
EXPECTED RESULT #2 Enhanced Canadian industry competitiveness.	1. Number of Canadian companies successfully obtaining national /international work orders.	100	**Target not met :** 90

Performance Summary and Analysis of Sub–Program

Expected Result #1

Fifty–one of the 90 companies that completed the State of the Canadian Space Sector survey, reported having generated a total of $1,660,706,237 in revenues from their goods and services exports — a slight decrease of $1,703,000 (> 1%) compared with the previous year.

Source: State of the Canadian Space Sector: http://www.asc–csa.gc.ca/eng/industry/state.asp

Expected Result #2

Comment: The 90 companies that completed the State of the Canadian Space Sector survey in 2011 reported having generated a total of $3,355,015,937 in revenues from their work orders ($1,694,309,701 from national sales and $1,660,706,236 from international sales) with public- and private-sector markets combined The number of companies obtaining work orders decreased slightly by 0.9% from last year.

The CSA continued to support space innovation and market access through its partnership with the European Space Agency in several areas: (1) European Advanced Research in Telecommunications Systems (ARTES), which gave our industry access to forward-looking studies on new telecommunications services; (2) Earth observation programs allowing Canadian companies to be involved in development of advanced space–borne instrument and sub–systems; and (3) European Aurora planetary exploration programs, the Lunar Lander mission and Life and Physical Sciences Programs, which position the Canadian industry and scientists in future exploration endeavours.

The CSA continued to ask industrial firms and research organizations to work on identified priority technologies in order to reduce risk for future missions of Canadian interest, and contributing to the enhancement of Canadian capabilities. Examples of development activities includes the following: Polar Communications and Weather; imaging sensors for astronomical instruments; technology for in–situ cellular or molecular analysis required for long-duration space missions; antenna prototype for multi–satellite acquisition; thermo-mechanical detector for observation of water; and the microsatellite bus.

The recommendations in the 2011 Enabling Technology Development Program evaluation report have been fully implemented with a few pending actions scheduled for completion in 2013. Program objectives were clarified within the PAA. A contribution mechanism was established and the program awarded contributions in the first quarter of 2013. A standardized prioritization process in which R&D technology needs are identified and prioritized was developed and implemented throughout 2012–13. The CSA also developed tools to clarify the major steps in the contract approval process, as well as the roles and responsibilities of each party involved. Lastly, the program adopted a formal method for communicating results to CSA clients.

Source: State of the Canadian Space Sector http://www.asc–csa.gc.ca/eng/industry/state.asp

SSPs Overall Achievements vs. Planned Targets

In 2012–13, the targets of 2 of the 3 indicators were met. 1 indicator was not measured in SSP 1.3.2.1 International Market Access.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
38.6	32.7	5.9

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
15.9	17.2	(1.2)

Due to rounding, decimal points may not add up to total shown.

This Sub–Program is further divided into two Sub-Sub-Programs:

*1. **Sub-Sub-Program 1.3.2.1. International Market Access***

Description: This SSP consists in facilitating foreign market access by the Canadian space industry through negotiating, implementing and managing special international arrangements. For example, in return for CSA monetary contributions to the ESA under the long–lasting ESA–Canada Agreement, Canadian industry obtains some of the contracts awarded by ESA; thus penetrating a market that would otherwise be limited to Europeans. This SSP increases access to foreign government market share for Canadian industry.

This SSP is delivered through concluding international agreements, trade measures, or other mutually beneficial arrangements that create a favourable political or trade environment that facilitates access to global markets.

EXPECTED RESULT #1

Canadian investments under the ESA Agreement give Canadian industrial firms access to the European institutional market.

Indicator	Performance
1. Ratio between the actual value of contracts awarded by ESA to Canadian organizations and the ideal value of contracts awarded by ESA to Canadian organizations (Canadian industrial return coefficient). (Target: 0.95 or higher.)	**Target exceeded:** 0.99

Additional Information

Note that the ESA reports are always published with a minimum 3 month time frames.

The industrial return coefficient (weighted value of contracts awarded to the industry of a State/Ideal value for that state) is used by the European Space Agency (ESA) to report on the application of the ESA's industrial policy. The program level coefficients are used to determine the necessary adjustments, if any, at the end of a program or period. Approximately every 5 years, formal reviews are conducted to assess whether or not the minimum overall return approved and guaranteed by the ESA Council for the period has been obtained. Corrective measures are identified for under-return.

Source: Geographical distribution of contracts (ESA/IPC (2012)13, rev3, corr1 – p. 13) published on March 11, 2013, and covering the period from January 1, 2000 to December 31, 2012.

EXPECTED RESULT #2

The Canadian industry has access to flight opportunities for its technologies/components.

Indicator	Performance
1. Number of technologies or components developed by Canadian industry that have been space qualified and/or acquired flight heritage–through Canada's participation in ESA Programs. (Target: 5 opportunities over the remaining term of the Canada-ESA agreement — 2012–19).	**Not measured in 2012–13:** Since the renewal of the agreement, no technology or component in development has been space qualified thus far. Progress is expected in 2013–14.

Additional Information

The Proba V mission was launched in May 2013. It has onboard navigational guidance software developed by NGC.

The launch of three SWARM satellites is scheduled for October 2013. They have an electric field Instrument developed by ComDev onboard.

These flights will be reported in the 2013–14 DPR.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
29.6	23.8	5.9

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
4.1	2.8	1.3

Due to rounding, decimal points may not add up to total shown.

2. *Sub-Sub-Program 1.3.2.2. Enabling Technology Development*

Description: This SSP consists of technology development and demonstration activities that contribute to maintaining or developing a technological edge in promising fields, such as switches, batteries, launchers, antennas, solar panels, etc. This SSP fosters as the enabling (generic) technology developed reduces costs and technological risks on multiple mission types, enhances the efficiency or performance of already established space solutions, and facilitates the commercialization of new products through innovation.

This SSP is performed with industry and is formalized under contracts or contributions.

EXPECTED RESULT #1

Increased technological capability of Canadian industry.

Indicator	Performance
1. Number of various technologies addressed and progress in their development in relation to the technology development plan. (breakdown by mechanism). (Target: 13)	**Target exceeded:** 21 technologies; 3 critical technologies for the Polar Communication and Weather Mission; 9 mission enabling technologies; 1 innovative technology; 1 industrial capacity enhancement; and 7 contributions to industry for spacecraft platform technologies.

Additional Information

The CSA continued to ask industry and research organizations to work on identified priority technologies in order to reduce risks associated with the technologies required for future missions of Canadian interest and contribute to the enhancement of Canadian capabilities. The priorities were determined through a prioritization process that takes into account the CSA's long--term mission roadmaps as well as consultation with industry and academia. Some examples of science and technology development activities are the following:

- Critical technologies to reduce risks and enable implementation of the Polar Communication and Weather (PCW) and similar HEO missions;
- New generation of imaging sensors operating in the visible and near infrared region for the purpose of improving astronomical instruments;
- "Lab-on-a-chip" technology for in–situ cellular or molecular analysis required for long-duration space missions;
- Digital beam forming antenna prototype for multi-satellite acquisition; and
- Thermo-mechanical detector for the spatial heterodyne observation of water.

13 new mission-enabling technologies were identified through a priority process and will be part of the next Request for Proposals.

17 new generic technologies were identified through a priority process and will be part of the next Request for Proposals.

A pilot industry contribution program was implemented for non–repayable contributions in the area of spacecraft platforms.

Source: Internal reporting documents.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
9.0	8.9	0.1

Due to rounding, decimal points may not add up to total shown.

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
11.9	14.4	(2.5)

Due to rounding, decimal points may not add up to total shown.

Sub–Program: 1.3.3. Qualifying and Testing Services

Description: This SP consists of specialized activities and services for the assembly, integration, and testing of space hardware and involves space qualifying technology, sub–units, units or entire spacecraft developed by Canadian academic institutions, government organizations, and industry, as well as international partners and clients. This SP fosters that mission–assigned technology and entire systems can safely ensure and reliably meet the rigors of space and to demonstrate the suitability and effectiveness of new Canadian space technology for providing valuable contributions to space missions. This provides an effective base for increasing Canada's capability to participate in future space programs. This SP is delivered by the CSA's David Florida Laboratory on a fee–for–service basis.

2012–13 Program Performance Measurement			
Expected Result #1	**Performance Indicators**	**Targets**	**Actual Results**
Test results of space hardware prove to be reliable in demonstrating suitability for the launch and space environment.	Maintenance of DFL's certification and compliance with the ISO 9001:2008 standard.	Certification maintained.	**Target met:** Maintained as measured in two internal and two external annual audits.
	Client satisfaction surveys measuring the quality of services provided.	Positive feedback on service quality.	**Target met:** Overwhelmingly positive response without any significant issues raised.

Performance Summary and Analysis of Sub–Program

Expected Result #1

Indicator 1

External audits were conducted on May 16–17, 2012 and November 1, 2012, and the internal audits were conducted on September 28, 2012 and February 5, 2013.

Source: Internal documents.

Indicator 2

Fifty–seven [57] surveys were sent out and 16 were returned for a 28% return rate.

The DFL continued to provide world–class and cost–effective environmental space qualification services for the assembly, integration and testing of spacecraft systems for the CSA's programs, as well as national and international clients. The hardware for many priority projects in 2012–13, such as the following, was assembled and tested at the DFL:

- Space Exploration: Follow-on work related to engineering activities for the James Webb Space Telescope Fine Guidance Sensor.
- Space Utilization: Testing on the M3MSat communications satellite; full assembly, integration and test campaign on the NEOSSAT spacecraft; and component and subsystem level testing for the RADARSAT Constellation Mission (RCM).
- Commercial: major projects supported included the following:

- MDA/Space Systems Loral SATMEX 8 and OPTUS 10;
- MDA various antennas and reflectors;
- MDA – Sapphire satellite;
- Alenia – SICRAL spacecraft components;
- Neptec – TRIDAR;
- University of Toronto – AISSAT Satellite;
- RYMSA – antennas; and
- TenXc Wireless Communications Systems.

Source: Internal financial records.

2012–13 – Financial Resources ($ in millions)

Planned Spending	Actual Spending	Difference
6.5	5.9	0.6

2012–13 – Human Resources (Full–Time Equivalents [FTEs])

Planned	Actual	Difference
34.4	37.5	(3.1)

Planning and Reporting Continuity
RPP 2012-2013 and DPR 2011-2012:
http://www.asc-csa.gc.ca/eng/publications/rp.asp

To learn more about enabling technology development, go to:
http://www.asc-csa.gc.ca/eng/programs/default.asp

To learn more about qualifying and testing services go to:
http://www.asc-csa.gc.ca/asc/eng/dfl/default.asp

2.2.4) PROGRAM – 1.4 INTERNAL SERVICES

Description: In accordance with the Management Accountability Framework this Program serves to implement the government's commitment to modern Public Service management. Internal Services include only those activities and resources that apply across an organization in the areas of Governance and Management Support which includes Management and Oversight Services, Communications Services, and Legal Services; Resource Management which includes Human Resources Management Services, Financial Management Services, Information Management Services and Information Technology Services; and Asset Management which includes Real Property Services, Material Services and Acquisition Services.

2012–13 Financial Resources ($ in millions)

Total Budgetary Expenditures (Main Estimates)	Planned Spending	Total Authorities (available for use)	Actual Spending (authorities used)	Difference
43.7	45.0	51.3	49.4	(4.4)

Due to rounding, decimal points may not add up to total shown.

Any significant variance reported in relation to the Planned Spending set out in the 2012–13 RPP is explained in Section 4.2.1 – Spending by Program.

2012–13 Human Resources (FTEs)

Planned	Actual	Difference
267.0	262.8	4.1

Due to rounding, decimal points may not add up to total shown.

Internal Services 2012–13 Program Performance Measurement			
EXPECTED RESULT #1	**PERFORMANCE INDICATOR**	**TARGETS**	**ACTUAL RESULTS**
Internal Services provide CSA managers with added value in the performance of their duties.	1. The CSA's rating in relation to MAF criteria based on the Round XIX assessment.	"Acceptable" rating maintained.	**Target partially met:** Ratings for the 6 Areas of Management assessed: "strong" = 2 "acceptable" = 3 "opportunity for improvement" = 1

PERFORMANCE SUMMARY AND ANALYSIS OF PROGRAM

In 2012–13, the TBS's assessment of the CSA's management capacity was positive overall. For the 6 Areas of Management (AoM), 5 AoMs remained stable, compared to last year, and 1 rating has decreased. The ratings are as follows:

"Strong" for AoM 1 (Values and Ethics) and AoM 10 (People Management).

"Acceptable" for AoM 6 (Evaluation), AoM 7 (Financial Management), AoM 9 (Risk Management).

"Opportunity for improvement" for AoM 5 (Internal Audit) which decreased from "acceptable". The CSA's internal audit completion rate relative to the 2012–13 Risk-Based Audit Plan is low. The CSA is encouraged to continue carrying out the planned audits in its risk–based audit plan and to follow–up on the implementation of its management action plans.

The CSA made progress in meeting two of the three management priorities identified in last year's MAF assessment for non-core AoMs:

AoM 2 (Managing for Results) – The CSA demonstrated a slight improvement in its use of Management Resources and Results Structure information in Treasury Board submissions.

AoM 8 (Management of Security) – The CSA completed and obtained Deputy Head approval of its Departmental Security Plan, as required under the *Policy on Government Security*. In addition, the organization submitted clear timelines for developing and implementing solutions for all outstanding security issues identified in previous MAF rounds.

The CSA did not make progress in one of the three management priorities identified in last year's MAF assessment for non-core AoMs:

AoM 15 (Investment Planning and Management of Projects) – Investment planning and management of projects are a fundamental part of the CSA mandate. To date, the CSA has not completed the transition to the Treasury Board's *Policy on Investment Planning – Assets and Acquired Services*. A final version of the CSA's Five-Year Investment Plan was submitted to TBS, but the formal submission was delayed to 2013–14 in order to incorporate the results of the CSA's review of strategic priorities. Additional clarifications concerning

project management requested by the TBS were addressed in parallel with progress made with the governance structure review.

LESSONS LEARNED

Overall, the CSA improved its collaborative relationships with government partners by revamping its governance structure, and strengthened its coordination and consultation activities with central agencies.

A roadmap for completing the review of all CSA governance aspects was produced and used as a guide in developing sound governance, such as the establishment of "considerations" to be used in future CSA investment decisions, the application of guidelines for the preparation of business cases to support investment decision-making, and the development of a CSA-wide project management policy and methodology to be completed during the 2013–14 fiscal year.

Planning and Reporting Continuity
RPP 2012-2013 and DPR 2011-2012:
http://www.asc-csa.gc.ca/eng/publications/rp.asp

SECTION 3: SUPPLEMENTARY INFORMATION

3.1 FINANCIAL HIGHLIGHTS

The financial highlights presented below provide a general overview of the Agency's financial position and operations. More detailed information is provided in the Agency's financial statements available at the section *Quarterly Financial Reports*[16] and which are prepared using an accrual accounting basis. The following explains the variances in each major grouping based on the most significant factors that affected each grouping during the fiscal year.

3.1.1) Condensed Statement of Operations and Departmental Net Financial Position

Canadian Space Agency
Condensed Statement of Operations and the Agency's Net Financial Position
(Unaudited)
For the Year Ended March 31, 2013
($ in millions)

	2012–13 Planned Results	2012–13 Actual	2011–12 Actual	$ Change (2012–13 Planned vs. Actual)	$ Change (2012–13 Actual vs. 2011–12 Actual)
Total expenses	364.1	334.5	471.4	29.6	(136.9)
Total revenues	–	0.9	21.4	(0.9)	(20.5)
Net cost of operations before government funding and transfers	364.1	333.6	450.0	(30.5)	(116.4)
Agency's net financial position	1,233.5	1,208.9	1,219.8	(24.6)	(10.9)

[16] The *Quarterly Financial Reports* are at the following address: http://www.asc-csa.gc.ca/eng/publications/qfr.asp

3.1.2) Condensed Statement Financial Position

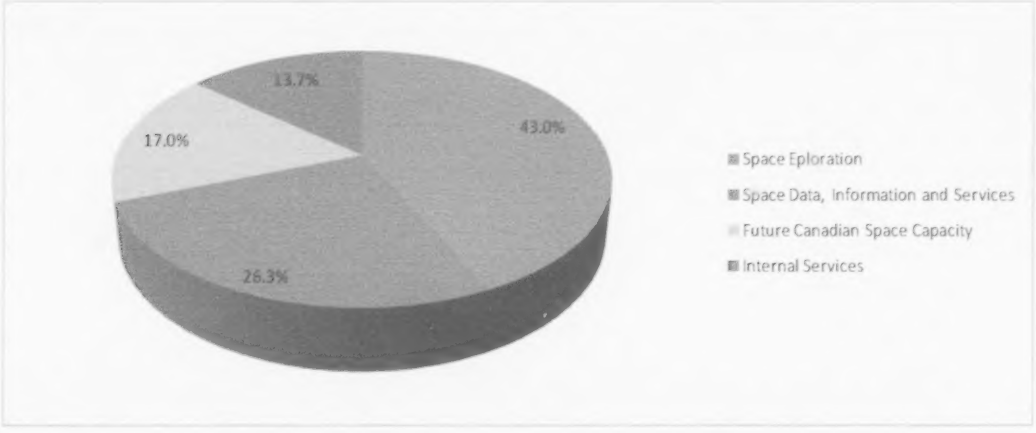
The Condensed Statement of Financial Position should have the following format and information:

Canadian Space Agency Condensed Statement of Financial Position (Unaudited) As at March 31, 2013 ($ in millions)			
	2012–13	**2011–12**	**$ Change**
Total net liabilities	117.1	122.0	–4.9
Total net financial assets	84.4	86.1	–1.7
Agency's net debt	32.7	35.9	–3.2
Total non–financial assets	1,241.6	1,255.7	–14.1
Agency's net financial position	1,208.9	1,219.8	–10.9

3.2 FINANCIAL HIGHLIGHTS GRAPH

The financial highlights presented below provide a general overview of the Agency's financial position and operations. Explanations are provided for the variances in each major grouping, based on the most significant factors that affected each grouping during the fiscal year.

Expenses

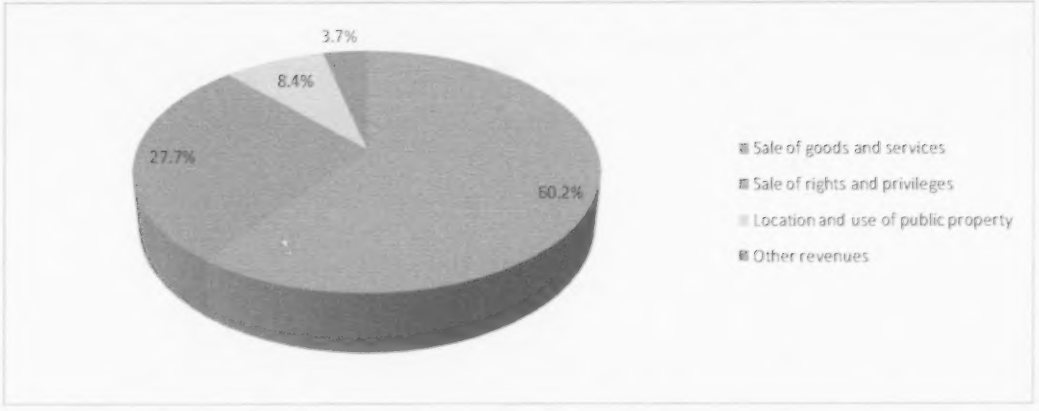


The total expenses were $334.5 million in 2012–13, a decrease of $136.9 million, compared with the previous year's total expenses of $471.4 million. This decrease is due mainly to the following items:

- Decrease in professional services because of the ending of Economic Action Plan initiatives ($50.4 million) in 2012;
- Decrease in amortization expenses as a result of the extension of the useful life of some International Space Station (ISS) assets. Following the announcement in February 2012 that Canada was extending its commitment to the ISS from 2015 to 2020, the useful life of these assets was extended for the same period, which had the direct effect of decreasing the amortization expense ($27.4 million);
- Decrease in transfer payments ($13.7 million) mainly attributable to variations in the European Space Agency's payment schedules; and
- Implementation of changes announced in Budget 2012.

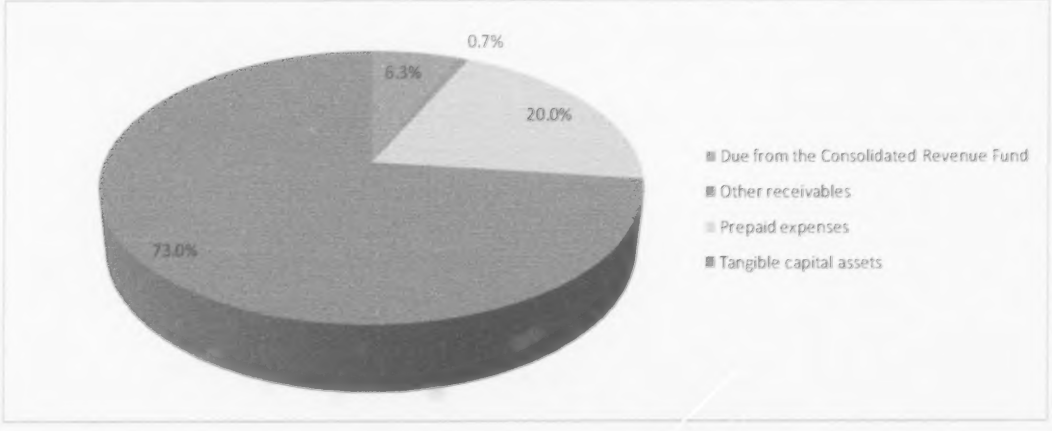
The total amount of planned expenses in 2012–13 was $364.1 million, a variance of $29.6 million (8.1 percent), compared with the actual expenses of $334.5 million. The variance between the planned and actual expenses is due mainly to a variation in amortization expenses, such as the change in the useful life of space assets, which was not taken into consideration in the calculation of planned amortization.

Revenues



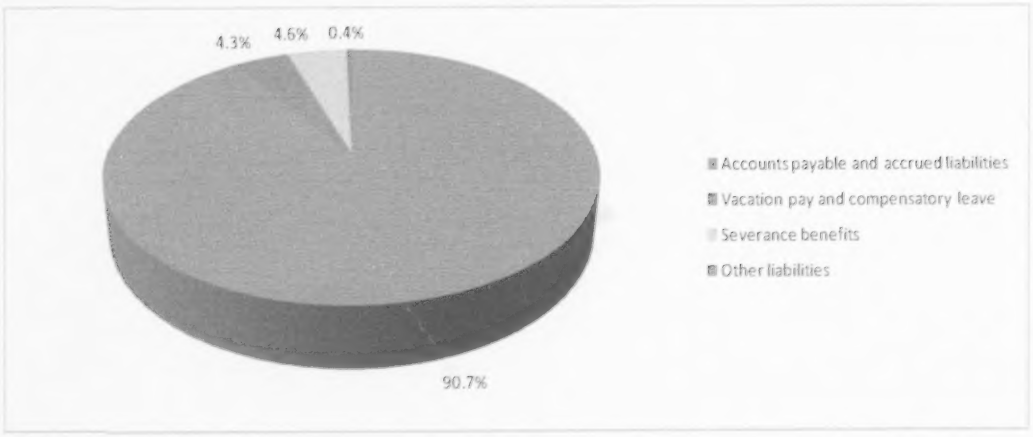
The Agency generated revenues of $3.6 million in 2012–13 ($27.4 million in 2011–12), $2.7 million of which are non-respendable. The Agency's respendable revenues were $0.9 million ($21.4 million in 2011–12). The decrease is attributable to the recognition in 2011–12 of an exceptional revenue amount of $20.8 million related to a non-monetary agreement between the Agency and NASA.

Assets



Assets held by the Agency for use in its activities consist primarily of tangible capital assets, which are 91.6% space-related. Total assets were $1,326 million at the end of 2012–13, a decrease of $15.8 million (1.2%) from the previous year's total assets of $1,341.8 million. This decrease can be explained by the decrease in prepaid expenses ($49.3 million), due mainly to RADARSAT-2 imagery received during 2012–13, combined with the increase in tangible capital assets ($35.3 million) due to an increase in space-related assets under construction (such as RADARSAT Constellation Mission [RCM]).

Liabilities



Total liabilities were $117.1 million at the end of 2012–13, compared with $122.0 million for 2011–12; therefore, there were no significant change. Accounts payable and accrued liabilities are mostly related to accruals in support of programs such as Space Utilization and Space Exploration.

3.3 FINANCIAL STATEMENTS

Information on the CSA's Financial Statements can be obtained at the following address: http://www.asc-csa.gc.ca/eng/publications/rp.asp#rr

3.4 LIST OF SUPPLEMENTARY INFORMATION TABLES

The following electronic supplementary information tables listed in the 2012–13 Departmental Performance Report[17]: can be found on the Canadian Space Agency website:

- Details on Transfer Payment Programs (TPPs)
- Internal Audits and Evaluations
- Response to Parliamentary Committees and External Audits
- Sources of Respendable and Non–Respendable Revenue
- Status Report on Major Crown and Transformational Projects
- Status Report on Projects Operating with Specific Treasury Board Approval
- User Fees Reporting

3.5 TAX EXPENDITURES AND EVALUATION REPORT

The tax system can be used to achieve public policy objectives through the application of special measures such as low tax rates, exemptions, deductions, deferrals and credits. The Department of Finance publishes cost estimates and projections for these measures annually in the Tax expenditures and Evaluation[18] publication. The tax measures presented in the *Tax Expenditures and Evaluations* publication are the sole responsibility of the Minister of Finance.

[17] Canadian Space Agency website: http://www.asc-csa.gc.ca/eng/publications/rp.asp
[18] The Tax Expenditures and Evaluation publication is at the following address: http://www.fin.gc.ca/purl/taxexp-eng.asp

SECTION 4: OTHER ITEMS OF INTEREST

4.1 ORGANIZATIONAL CONTACT INFORMATION

Canadian Space Agency
Communications and Public Affairs
Telephone: 450-926-4370
Fax: 450-926-4352
E–mail: media@asc-csa.gc.ca

4.2 ADDITIONAL INFORMATION

4.2.1) Spending by Program

Description	Planned Spending ($ in millions)	Actual* ($ in millions)	Variance ($ in millions)
Space Data, Information and Services	173.7	130.8	42.8

Comments

The variance was due mainly to the three following factors:

- Reprofiling of $28.5 million (from 2012–13 to 2013–14) as a result of changes in cash flows required for the RADARSAT Constellation Mission (RCM). Because of the longer delays in obtaining the authority for the RCM implementation phase, the schedule for Long Lead Items procurement (LLI) required adjustments, and therefore, the reprofiling began at the time of the 2013–14 Annual Reference Level Update and was completed during the Capital Budget Carry Forward exercise.
- When the planned spending exercise for 2012–13 was conducted, the available information for the RCM was an estimate based on the anticipated Capital Budget Carry Forward amount from 2011–12 to 2012–13. Therefore, once the RCM implementation phase was approved, the estimated amount proved to be overvalued by approximately $11.5 million, thus making it unnecessary to access the capital budget carried forward from 2011–12 to 2012–13.
- The implementation of changes announced in Budget 2012.

Description	Planned Spending ($ in millions)	Actual* ($ in millions)	Variance ($ in millions)
Space Exploration	106.3	87.5	18.8

Comments

The variance was due mainly to the three following factors:

- A decrease of $14.2 million planned for the supply of a Canadian instrument by the CSA that was no longer needed after NASA's announcement to withdraw from its participation in the European mission ExoMARS/MATMOS mission because of budgetary reallocations.
- Reprofiling of $3.4 million (from 2012–13 to 2013–14) in the capital budget in order to make cash flow adjustments due to delays in the following mission projects: CAMS, Osiris-REX, the James Webb Space Telescope (JWST) and NEOSSat.
- The implementation of changes announced in Budget 2012.

Description	Planned Spending ($ in millions)	Actual ($ in millions)	Variance ($ in millions)
Future Canadian Space Capacity	63.3	52.5	10.8

Comments

The variance was due mainly to two factors:

- A reprofiling of $5.4 million from 2012–13 to future years for the ESA program due to the fact that the budgetary cycle of ESA differs from Canada's, the slippage in the planned disbursements of ESA programs and the non realization of some budgeted risks such as potential cost increases in ESA programs, inflation and exchange rate fluctuations.
- The implementation of changes announced in Budget 2012.

Description	Planned Spending ($ in millions)	Actual* ($ in millions)	Variance ($ in millions)
Internal Services	45.0	49.4	(4.4)

Comments

The variance was due mainly to the three following factors:

- A spending increase of ($3.4) million due to repayable eligible pay list expenditures.
- A spending increase of ($1.5) million resulting from reallocations from other programs to cover infrastructure costs at St. Hubert and the David Florida Laboratory.
- The implementation of changes announced in Budget 2012.

4.2.2) FTEs Variance (Full–Time Equivalent)

Planned	Actual	Difference
687.0	643.5	43.5

Difference between FTEs is a result of the Agency's implementation of the changes announced in Budget 2012.